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A PLEA FOR AMERICAN ARCHÆOLOGY.*

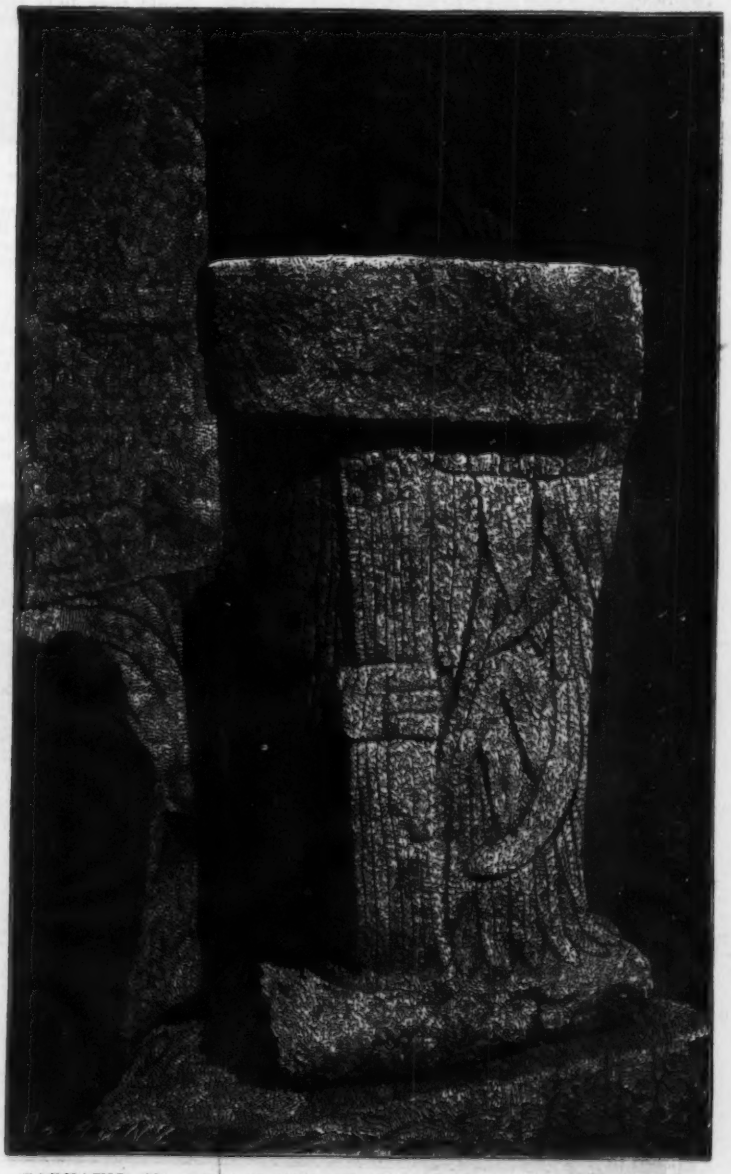
I HAVE sometimes wondered why in the past so little interest has been taken in American archæology, but I think that the cause is easily found. It is that until recently the study of archæology has been directed to the collection of the finished products, and these products, as well as the archæology of the producing race, have been praised or condemned according to their æsthetic or artistic values. Archæological explorations and excavations have been carried on with the one purpose of finding masterpieces of art, which now fill the museums of all countries, or the wonders of architecture which attract the admiration of all who visit Greece, Italy, Sicily, Egypt, and Asia.

INNER APARTMENT OF CHAACMOL'S MONUMENT, WITH STONE ALTAR SUPPORTED BY FIFTEEN CARYATIDS.

Surely no one would wish that a single one of these specimens of art or architecture were absent, or that one word of the praise that has been showered upon these products of past races should be withheld or abated. Certainly no true friend of American archæology feels aught but pride in what has been accomplished in other lines outside of his own.

But satisfaction in the product leads to interest in the producer. What was his mode of life, his customs, his games, his religion, his method of production, and, in addition to these, what were his antecedents, or, in other words, his progress? What steps had been taken by him and his predecessors which enabled him to produce his machine, his statue, his building? This search for knowledge of the progress of a race toward civilization would have been less successful had not certain survivals and close observation of other races produced a theory which is now widely recognized and which may be stated briefly as "like under like conditions produces like," or the theory of the solidarity of the human race. Man living on roots and herbs needs

CARYATID IN MAUSOLEUM OF CHAACMOL, YUCATAN (FRONT).



CARYATID IN MAUSOLEUM OF CHAACMOL, YUCATAN (BACK).

* A paper by Prof. Charles P. Bowditch, of Boston. Read December 28, 1899, before the Archæological Institute of America, assembled in the Art School of Yale University. Specially reported and revised for the SCIENTIFIC AMERICAN SUPPLEMENT.

shelter and seeks the protection of a cave or tree, no matter whether he lives in Asia, Europe, or America, and he shows his appreciation of the shelter by some sort of thanksgiving directed to the sheltering object. He tries the flesh of some dead animal or clothes himself in its skin, and at once devises plans for killing the living animal. For this purpose he manufactures the arrow and javelin with their stone heads, and if the same kind of stone is at hand in Europe and America, the European and American savage will each chip his arrowhead so that none but an expert, and not always he, can point out any difference between the two. If they want a method of making a noise, they both find that a hollow log, or better still a stretched skin, will answer the purpose, or they will perhaps make a bull roarer and use it for the same purpose of keeping away some part of the tribe from a ceremony which is tabooed to them.

The inhabitants of Central America at the time of the Spaniards' arrival may be roughly divided into

THE MONUMENT OF CHAACMOL, AT CHICHEN ITZA, YUCATAN.

two races, the Nahua or Nahuatl, and the Maya. This is not absolutely accurate, but in a general way the former may be said to have occupied the north of the country and the higher altitudes with branches extending to the south and the lower slopes, while the Mayas occupied the lower altitudes and the shores of Guatemala, Mexico, and Yucatan, with a branch extending northerly on the Gulf of Mexico. Of these two races, the Maya had reached a decidedly higher state of civilization.

The knowledge which we have of these races is derived from Spanish sources, from native records, and from the results of the exploration of the ruins which are scattered in large numbers over the country; and since as a rule the explanation of the native records rests on the information contained in the records written in Spanish, it is very important to know who these Spanish writers were, and to what degree of authority they are entitled.

The Spanish writers were mostly Catholic priests, though Bernal Diaz and Tapia were Spanish soldiers, and Ixtlilxochitl was a direct descendant of the rulers of Tezcoco, one of the principal cities on the high tableland of Mexico; several were bishops and men of authority and culture. The priests came among the newly conquered people to teach them the Christian religion and conscientiously set to work to learn the native language, to get an insight into their modes of thought, and to gain as full a knowledge as possible of the rites and ceremonies of the native religion.

This effort to become acquainted with the native languages and beliefs was not the result of any anthropological or even humanitarian interest, to converse freely with the Indians, to gain their confidence, but mostly of a wish to know what arguments were the best to use and what obstacles had to be overcome in turning the inhabitants to Christianity. It is true, however, that the priests were often the best friends of the Indians, and stood between them and their oppressors, the Spanish soldiers, who had come to America to satisfy their avarice and their lust. One of the noblest of these Spanish priests, Las Casas, spent many years among the Indians trying to defend them from the rapacity of their conquerors; and another, Sahagun, brought together the oldest and wisest of the Indians and induced them to write down in their own way the history and customs of their country, and to explain the meaning of their peculiar writing.

Such being the objects of the priests, what authority should they have with us, when they set forth the habits of the races among whom they dwelt? In the minor details, which concerned the relation of these people to Christianity, they may have looked at what they saw with prejudiced eyes, and their words may be open to suspicion. Thus when they find the Christian cross in the crosses which are so numerous in Central America, when they find Saint Thomas in Quetzalcoatl, and when they identify the Toltecs (whoever these may be) with the lost tribes of Israel, we may not wish to follow them; but when they tell us of the customs of the Indians, of their rites and ceremonies, their modes of government and education, their markets and fairs, what motive could they have had for not telling us the truth? Why may we not trust the chroniclers in this matter as much as we trust more modern historians?

The purely native records are far too few for our thorough knowledge. They consist:

1. Of picture writings of the Nahuas made before the arrival of the Spaniards. These are very few owing to their destruction by Spanish priests.

Of picture writings of events which occurred either before or after the coming of Cortez, but which were either copies of older monuments or were drawn for the information of the courts or higher officers, or for the instruction of the Spaniards.

2. Of picture writings of the Mayas filled with hieroglyphs, pictures, and calculations. Of these only three are known.

Of books of the Mayas written in the Maya language but in Spanish characters.

3. Of the Popol Vuh, a book of the cosmogony of the Quiches of Guatemala, which was written or copied after the Spaniards came, as it is in Spanish characters and may possibly have felt the effects of Christian thought and tradition.

4. Of the inscriptions, hieroglyphics, and pictures carved in stone, modeled in plaster, or painted on the inside or outside of the buildings and temples.

These with the contents of the tombs and the accompaniments of the dead are the records of the native races themselves.

And what information do we gain from the accounts of the Spanish conquerors and missionaries, from the native writers, from the more lasting stone records, and from the facts which the tombs reveal to us?

Speaking briefly of the Mayas, we learn that the Spaniards found a race of men well advanced in many of the paths of civilization. They were separated into two classes, the nobles and priests forming the higher grades, while the common people, established in some respects probably on a communal basis, were the laborers of the nations or tribes. Their trades were principally agriculture, carpentry, masonry, the making of pottery, the weaving of cotton cloth, the manufacture of paper, the carving of idols, the evaporation and manufacture of salt, the curing of skins, besides hunting and fishing. Their traveling merchants carried on their business with the neighboring and even distant tribes or nations, carrying salt, cotton stuffs and slaves to exchange for cacao and precious stones, metals and feathers. They had rules of inheritance, the sons practically taking the parents' property, and the shares of minors being held by the nearest relative as trustee. The latter rendered an account when the minor became of age, and not to return an honest account was considered a great crime.

There is some reason for believing that the ground was tilled in common, though on the other hand there is evidence that a certain portion of land was set apart for each married man and his wife, and that they helped each other in bands of twenty, more or less, at the time of sowing their grain. Later, after the coming of the Spaniards, the land seems to have been held in common or to have belonged to the towns, and the first comer had the right of occupancy; but this would seem to have been the result of the disintegration consequent on the Spanish conquest.

A part of the men were chosen as soldiers. They came together when summoned by their leaders, and if they were not sufficient for the purpose in hand, further recruits were collected.

Their social relations were of a high order, money was lent and borrowed without usury. Their ancestry and their elders were held in the highest respect. The family was a well defined unit, though divorce was easy and frequent. Their women were virtuous until, as the Spanish bishop says: "Antes que conociessen nuestra nacion" ("before they became acquainted with our people"); they brought up their daughters admirably to be economical housewives and good mothers.

In architecture they were proficient. Their buildings, scattered over the whole extent of Yucatan, and in the lower altitudes of the Cordilleras, testify to their taste and skill in architecture, and there we find remains which, considering that the flat rock was used, that no attention has been paid to them for three hundred and fifty years, that they have been the quarries of modern towns and buildings, that the despoiling traveler and treasure seeker have had free play, that the tropical vegetation has driven its penetrating roots into the walls and roofs, and that the feet of men and animals have wandered over them, are in a remarkable state of preservation. Indeed, one of the expeditions of the Peabody Museum occupied rooms in the so-called Palace of Labua, which could have had no repairs made upon it for three hundred and fifty years, and yet, in spite of its flat roof covered with soil and shrubs and trees, no drop of rain filtered through the ceilings.

These buildings, in spite of what may be said by the advocates of the theory of communal houses, were not

SCULPTURED STONE WORK.

DISCOVERY OF TWELVE SERPENTS' HEADS.

the dwellings of the people but of the priests and nobles, while artificial mounds from fifty to one hundred feet high were the pedestals of their temples, made as all nations have made their houses of worship, with their summits pointing toward the heavens.

The Mayas were remarkable road builders. The holy city of Izamal, to which devotees came from all quarters, had four great roads running to the four points of the compass, so as to make easy the path of the pilgrim, as well as that of the merchant. I myself have ridden for miles along one of these roads,

THE STATUE OF CHAACMOL.

and have found the cement of which it is made as hard and strong as it was when it was built, indeed, in some places, the old road was in better condition (except for the trees growing upon it) than the road by its side upon which I was traveling.

Such was the material knowledge of these native tribes. Their intellectual exploits were of no inferior order. In common with all the Central American races (and this is a fact which tends to show either a community of origin or a close connection from amicable commerce or from conquest by war) they had the peculiar calendar which by a combination of twenty days with the numbers 1 to 13 gave the sacred or divinatory period of two hundred and sixty days, the Tonalamatl of the Mexicans. This, in turn, in connection with the year of three hundred and sixty-five days, gave the longer era of fifty-two years, in which no day with the same number can fall upon the same day of the same month. This calendar is unique among all the nations of the world, and is, to my mind, the most convincing evidence of an indigenous origin or of a separation from some other race so far in the past that it would be impossible to say which of the two prehistoric tribes was the parent.

Their powers of numeration were not taxed by the highest numbers. Their numbers ran into the millions, and the Dresden Codex shows several instances where a fixed day is given, then a number of twelve million or more, and then another fixed day. A careful calculation shows that these two days are separated by the same number of days as that given by the large number. Their numeration was not decimal, but vigesimal, and instead of degrees of units, tens, hundreds, thousands, etc., running from right to left, they had degrees of units, twenties, three hundred and sixties, seventy-two hundreds, etc., running from below upward, the digits, so to speak, being combinations of dots meaning one, with straight lines meaning five.

They were careful observers of the heavenly bodies, knowing the revolution of the earth about the sun, the synodical revolution of Venus and probably that of Mars, while the revolutions of the moon were apparently calculated with such accuracy as to make the period 29 . 5255 or 29 . 5308, while the true revolution is 29 . 5306. They knew that five synodical revolutions of Venus were equal to eight solar years, and the observations of the rising and culmination of the Pleiades were very accurate, and among the Mexicans gave the time for the beginning of their new era, the rite of the new fire at the end of each fifty-two years.

There is much to debate as to the point which the Maya and Nahuatl races had reached in their progress toward a phonetic alphabet. While some investigators insist that picture writing, symbolical or otherwise, marks this point, others declare that a phonetic alphabet is found. The truth is probably somewhere between the two. Dr. Brinton gave the name "Ikonomatic" to the writing among the Mayas, saying that they had reached the art of writing in rebuses, where a word is represented graphically, having the same sound as a syllable of the word to be written, but having no similarity of meaning. Thus, to give an example in English, a picture of a cat, an ass, and a trophy would mean catastrophe, as is seen in the puzzle department of any of our newspapers for children. But they had gone further in two directions, I think:

First, they had so conventionalized the drawing of their cat, ass, and trophy (I still explain my meaning with the English rebus), that it is difficult to recall what was originally meant by the drawing. Thus, if instead of drawing a cat they had simply drawn its tail, and then instead of making what was clearly a cat's curved tail, they had used merely a curved line, after the lapse of years no one would know that this curved line had ever been the representation of a cat. And this is what has happened with some of our own letters.

Second, they had reached a point where the word selected was no longer used for representing the whole sound, but merely for a part of that sound. Thus, in Mexican we frequently find the banner pan used for expressing the whole sound "pan," and also for expressing a part of that sound, as "pa." If they had gone one step farther (and it is by no means certain that they did not, and indeed it seems as if they had actually taken the step in some cases) and had allowed the word "pan" no longer to mean "pa," but simply "p," they would have reached in that case at least a phonetic system. And it must be remarked that even with us, there are many letters which do not represent a single sound, but have a compound sound in them, as "i" is merely "a-e."

Such were the Central American races; and even if you may not agree with me that whatever the civilization of Spain itself may have been, the civilization which the Spaniards brought with them to Central America displaced a civilization which was decidedly superior to that of the conquerors. We may still well agree with Mr. H. H. Bancroft, when he says in his very valuable history, "I have no disposition to unduly magnify the new world civilization nor to underrate the old world culture, but during these ten centuries [he is speaking of the period from the sixth to the sixteenth century] of almost universal mediæval gloom, the difference between the two civilizations was less than most people imagine."

With such races and with such remains, both of material and of intellectual vigor, to be investigated, it would be strange indeed if the opportunity were neglected to carry on this work in the two lines which lie before us. The first of these is the exploration of the ruined buildings, which are scattered all over Central America, testing the mooted questions of the migrations of the races in the past and searching for further additions to the scanty number of manuscripts which have come down to us, and at the same time preserving in the form of photographs or of molds the many inscriptions in stone which have not yet been collected. The second line of work will be in the pursuit of the study of the Central American languages, without a knowledge of which it will be very difficult, if not impossible, to make much headway in the deciphering of the hieroglyphics and picture writings.

CARVED JADE.

PROSPECTIVE WEATHER FOR FEBRUARY.

THE following prognostications of weather by Mr. A. J. De Voe are based according to his ideas on the fact that there are eight vast storm belts hovering over the surface of the earth in different localities, and when they are over a given locality, disturbances occur as to heat, cold, wind, snow, or rain. These vast storm belts in the upper half of the western hemisphere are believed to travel from a southwest to northeast direction, having also a slight lateral motion to the southeast. He is unable to explain the probable cause of the formation of these vast storm belts, except on the theory that they follow lines of astronomical eclipses. He has invented an adjustable weather chart arranged for each year, so that weather for quite a period ahead can be foretold. He notes that early in the month of February very cold weather prevailed in consequence of a wind storm. Another great storm is promised to form

THE SERPENTS' HEADS AND ROUND URN.

over the lower Mississippi Valley on February 11, and will travel due east, reaching the South Atlantic States by the 13th, causing heavy rains in the Gulf States and heavy snow in all the Northern States from the 12th to the 15th, causing dangerous gales along the New England coast on the 15th and 16th and very cold weather.

The next storm will appear over the Gulf of Mexico by February 20, and will move nearly due north, causing extreme cold weather over the Northern States with snow. The storm center will pass nearly over New Jersey on the 23d, causing snow blockades west of New Jersey and heavy rains on the Atlantic coast, and from the 23d to 25th easterly gales will prevail along the Middle Atlantic coast. Another great storm will develop over the Gulf of Mexico on February 27 and move nearly due north, causing very cold weather over all the Northern States. The month of March will enter like a lion, with heavy rains over the eastern Gulf States. This same storm will reach the Middle Atlantic States by March 2, and the storm center will pass west of New Jersey, causing heavy snows over the Western States and very heavy rains along the Atlantic coast from the 3d to the 5th, probably causing also floods in the South Atlantic States. After this storm the cold wave will disappear along the Middle Atlantic coast, but very cold weather will continue over the Western States.

SCHNEIDER-CANET NAVAL TURRETS.

SHIP TURRETS WORKED BY ELECTRICITY AND BY HAND POWER, WITH CENTRAL AMMUNITION TUBE.

THE increasing importance given to the application of electric energy on board modern ships was a sure sign that this comparatively new source of power would find its place in the working of turrets. It was first applied in various forms in the Schneider-Canet system of ordnance, for working hoists, for the elevation and lateral training of guns, opening out of the breech, firing the guns, in night sights, etc. The marked preference given to the new system is, moreover, fully justified, for the working of such installations by means of a liquid under pressure is an incomplete and not a satisfactory solution of the difficulties encountered, notwithstanding the degree of perfection to which the hydraulic system has been carried after many years of experimenting with progressive designs. The main difficulties with the hydraulic system lie in the defects of principle that surround the applying of an hydraulic motor for this special use; among the most serious may be mentioned:

1. The system involves the use of a large number of pipes, the rapid repair of which is often impossible.
2. The influence which great variations in temperature may have on the general working of the system.
3. The difficulty of training the gun accurately and rapidly with a personnel that has not been previously fully trained to the work.
4. The practical impossibility of arranging the various parts in a suitable manner for working the turret by hand, should an accident happen to the hydraulic motor or any of its accessories.

The Schneider-Canet electric turrets are now in regular service, or in course of erection, on board a large number of modern men-of-war. Since the time when they first appeared they have given good results, and it may be said they solve the problem of electric transmission and power in this particular application. The general characteristics we have already enumerated are common both to hydraulic turrets and to those of similar design, worked by electricity, for in both designs the system is balanced round the vertical axis of rotation, and both embody a central arrangement for loading the gun; in addition, the Schneider-Canet type of electric turrets contains special arrangements, which may be summed up as follows:

1. Lateral training is insured by means of a hand lever placed within easy reach of the gunner, and which he moves in the direction he wishes to give the turret. This maneuver is of the simplest character and can be carried out by any untrained hand.
2. The rotary speed of the turret is proportional to the extent of travel of the hand lever, and training can be effected at all speeds up to the maximum. Whatever be the rate at which the hand lever is worked, the turret always steadily revolves and without shocks.
3. The turret, when revolving at full speed in one direction, can be reversed at full speed in the other direction, without injuring the system.
4. The system is so sensitive that even the largest turrets can be turned through less than $\frac{1}{10}$ deg. in either direction, and to effect this no special mechanism is necessary. No mistake is possible in the manipulation of the working devices, and the gun can always be exactly sighted.
5. The turret can be stopped suddenly, without shock, and without the weight of the moving mass exerting any local injurious strain.
6. If through mistake the gunner does not stop the turret before the extreme limit for training is reached, that is to say, before it strikes against the mechanical buffers, the system comes in contact with an electrical buffer that stops it automatically, while the connections return to zero under the action of a counteracting spiral spring.
7. The working apparatus proper, placed in the turret, takes up but little room, thus giving more space for the personnel; all the inside connections being prepared separately, the apparatus is easily put in place, and should it get injured in any way, it can easily be replaced by a spare one, the making up of the connections taking but little time.
8. All the Schneider Canet electric turrets are so arranged that if for any reason the electric motor is not used, the various operations — the training and the elevating of the gun, and the hoisting of the ammunition—can be performed by hand-worked direct-acting cranks.

We will now describe a few types of turrets, making a selection among those for guns of the usual calibers.

Closed Turret for One 12-centimeter (4·724-inch) Gun (Figs. 1 to 3).—This type of turret, which is manufactured for all quick-firing guns of medium caliber, insures complete protection, and is very easily worked. These turrets are illustrated by Figs. 1 to 3. Each turret consists of: *A*, the gun, carriage, and slide; *B*, the turret and its rotary mechanism; *C*, the training apparatus; *D*, the hoist. The carriage proper consists of a cradle provided with trunnions, the recoil cylinder is cast in one piece with it, and it completely surrounds the rear part of the gun. Two gun-metal rings facilitate, during recoil and return, the sliding of the gun in and out; the elevating arc is attached to the recoil cylinder. The gun is kept from turning by slide shoes. On the left trunnion is screwed the rod of the sight support. Leather linings on the rear surface form buffers for running out the gun. The hydraulic recoil cylinder is on the Schneider-Canet system with central counter-rod and independent recuperator. The piston rod is joined to the rear of the gun by means of a breech-end jacket. When the gun is fired, the recoil draws the piston with it, the pressure acting on the liquid in the rear of the cylinder; the liquid opens the communication valve and flows through the annular opening which surrounds the counter-rod. When the recoil is complete, the valve, pressed by its spring, falls back on its seat, and the liquid can only return to the rear of the cylinder through narrow openings. The gun is run out again smoothly under the action of two sets of springs, placed on the sides of the recoil cylinder, and which are compressed under the action of recoil. The slide consists of two cheeks, stayed together, the soleplates of which rest on the turret platform; at the top part of the cheeks are the trunnion plates, in which the trunnions are placed. On the left cheek is fixed the elevating gear of the lateral training mechanism. The pump for supplying the recoil cylinder with liquid is attached to the right cheek. The level of which it carries a helicoidal wheel; a series of friction rings is introduced to absorb the momentum of the turret in case the motor should be stopped too abruptly. The helicoidal wheel is actuated direct by an endless screw fixed to the shaft of the same motor. The latter is completely inclosed in a metal cylinder. It comprises a working shaft provided at the upper part with a handle, which the man in charge displaces over a graduated scale. The general way in which this apparatus works has been already described. The system is operated by hand by acting on a wheel, the shaft of which is on the right hand cheek of the mounting. A toothed wheel is keyed on the hand-wheel, and carries a chain that transmits the motion to a horizontal shaft passing through the slide, and carrying at its end a toothed wheel that can be thrown in and out of gear with the corresponding pinion on the electric motor shaft.

The gun is supplied with ammunition by means of a hoist consisting of two endless chains that turn, at their bottom, round a double-toothed wheel set in motion by the working parts of the mechanism; at the top they pass over a pulley, the frames of which are so arranged that the tension of each chain can be regulated. The chains are united by bucket-cup rings movable round horizontal rods, and in which the cartridges are placed, the projectile downward, the point being placed in a smaller cup. When a cartridge is placed in this position, the first cup partly surrounds the head of the projectile and draws it along. At the top the slide which guides the bottom of the cartridge case is

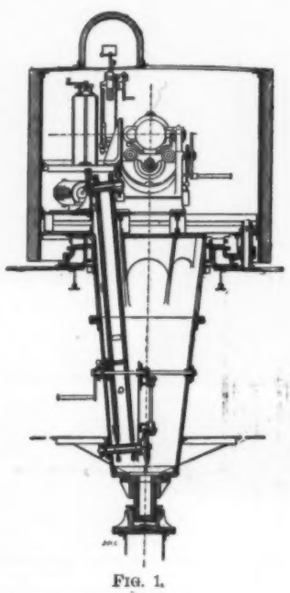


FIG. 1.

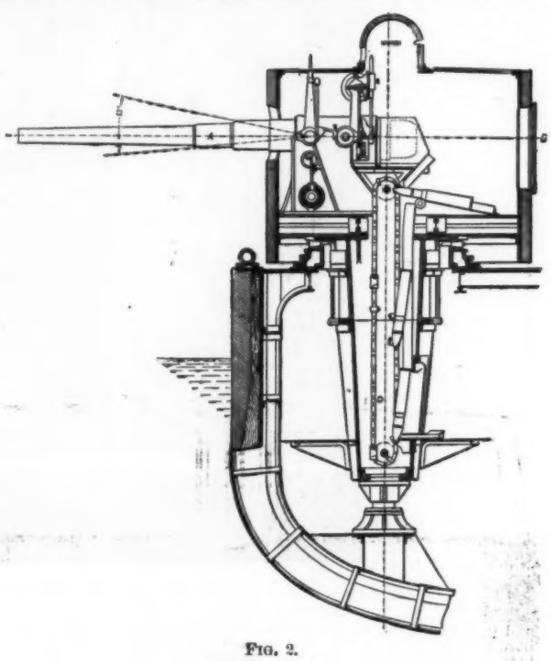


FIG. 2.

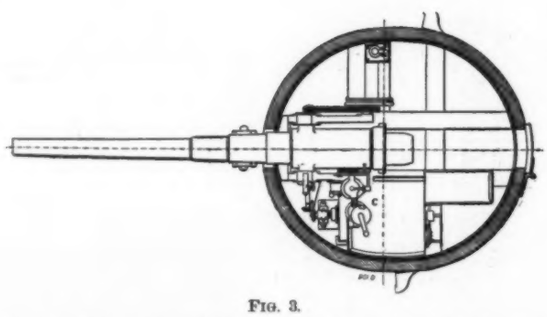


FIG. 3.

SCHNEIDER-CANET ELECTRICALLY WORKED TURRET FOR TWO 12-CM. (4·7-INCH) GUNS.

whole, comprising the mounting, the slide, and the armor, rests on the platform, which consists of plates carried on two longitudinal beams strongly braced; the platform is continued at the lower part by the central socket formed like a truncated cone, the platform and socket being connected by a cast-steel ring which forms a path for the horizontal and vertical rollers. The socket and turret rest on the plunger piston of an hydraulic cylinder that forms a step bearing; the hydraulic cylinder is fixed to the bottom frames of the ship, and is connected with an accumulator fed by a pump. This arrangement allows the movable part to be raised in order to free the horizontal rollers and inspect and repair the various parts on which the system rotates.

The device for elevating the gun is placed within easy reach of the gunner and consists of a hand wheel on a shaft, upon which are keyed two pinions that transmit motion through an endless screw and a set of gearing to the elevating arc fixed to the gun. An index fitted to the horizontal shaft of this mechanism travels over a scale and marks the angular position of the gun with relation to the platform. The lateral training mechanism can be worked electrically or by hand; the required motion is obtained by the rotation of a pinion moving with the turret and which engages the circular rack fixed to the ring that forms a path for the two sets of rollers. This pinion is keyed on a vertical shaft that passes through the platform, above the rounded, and slightly enlarged before reaching the inclined trough that receives the cartridge when this latter turns over round the axis of the corresponding bucket-cup. The hoist is worked by hand, by means of a crank placed inside the central socket, at the end of a horizontal shaft which carries a bevel wheel in the middle of its length; the rotary motion of the latter is transmitted to the wheel shaft through an intermediate vertical shaft, on which are keyed two other bevel wheels.

The sight and scale are carried in jointed supports, which follow the mounting in its displacements. They extend over the roof of the turret, the top of the scale being opposite the sighting opening. The gunner has, therefore, a wide range for executing all the sighting operations, and he can even follow a movable target. A sliding door closes the turret in the rear.

Closed-in Turret for Two 12-centimeter (4·724-inch) 45-caliber Quick-firing Guns (Figs. 4 and 5).—A description of this type is of special interest, and the turret we shall here describe is one forming part of the armament of a battleship.

The 12-centimeter (4·724-inch) guns are quick-firing, of the Schneider Canet system. They are fitted with one-motion breech blocks, arranged for firing both with electric and percussion fuse. A jacket, with shoulder extensions, surrounds the gun, and carries on the sides two slides that support and guide the gun during recoil by bearing on the top surface of the string-beams.

In front of the jacket are the buffers, and underneath is placed the recoil cylinder, in connection with which is a spring recuperator. The movable cradle consists of a front and rear collar and of the two lateral string-beams which unite them. The gun during recoil slides in the frame thus formed; the trunnions are in front. Gun-metal bearings placed inside the collars insure a perfect guiding of the system. The rear collar is made with a butt, on which is fixed the recoil piston-rod. The recoil cylinders are on the Schneider-Canet system, with central counter-rod. The gun in recoiling draws with it the recoil cylinder, the piston remaining fixed. The liquid passes from one side to the other of the piston, through an annular opening made between the regulating counter-rod and the central groove, and drives before it the movable bottom that carries the rear cross-piece. The Belleville springs are compressed until the recoil is complete; they then relax and push back the movable bottom, which drives the glycerine forward, and, as the valve is closed, the liquid can only flow slowly through narrow vents of calculated areas. The gun, therefore, runs out again without shock.

The movable part of the turret is balanced on its vertical axis of rotation. The platform consists of a flooring of steel plates strengthened by T-beams and by a ring made of angle-bars; it carries the pivoting column, which is in the shape of a truncated cone, and the roof. The guns are elevated by hand; to this effect each of the outside string-beams is fitted with a toothed sector which engages pinions keyed on the same shaft with a helicoidal wheel worked by an endless screw. On this shaft is keyed the handwheel operated by the gunner. The lateral training mechanism is worked by electricity or by hand; in the former case the motor, which is placed in the front part of the turret, drives, through an endless screw, a helicoidal wheel that operates an inside gearing with differential motion. This gearing is keyed on a vertical shaft, at the lower end of which is a pinion that gears with two other pinions placed symmetrically, and engage the toothed circular rack for lateral training. The gunner regulates the training at will by acting on the commutator. In the device for lateral training by hand power, the men work two cranks placed one on each side of the mountings; these transmit power through a chain to a shaft fitted with an endless screw which gears in a helicoidal wheel that surrounds the differential gearing above referred to. The helicoidal wheel operates the vertical shaft provided with a pinion which engages the circular rack for lateral training. The two mechanisms are absolutely independent one from the other.

Ammunition is raised to the top platform by means of a hoist placed in the central tube. The hoist consists of two endless chains between which are held the buckets which contain the cartridges. During the raising motion the cartridges are guided by gun-metal slides placed on the whole height of the tube; the chains are, moreover, provided with cross-pieces placed at the height of the cartridge-cases. The chains in descending are also guided in a brass tube; the buckets are thus kept in position and remain always suitably placed for receiving the cartridges to be raised. The automatic feed of the hoist is insured by a device worked by the chains and on which the men deposit the cartridges. For working the device, the chains are provided with suitable catches which act on a horizontal rack that sets in motion a pinion keyed on the shaft of the hauling-in arm; the latter consists of a fork-shaped lever which receives the cartridges in such a way that the bottom of the cartridge-case rests first on a small roller placed between the branches of the fork, the point of the projectile bearing against a catch at the opposite end; this catch disappears when the fork-shaped lever is raised, the cartridge reaches a vertical position, slides down and rests in the bucket which is ready to receive it. The hauling-in device holds the cartridge until the bottom of the cartridge-case enters the guiding-tube; it then falls back to its original position to take up a fresh charge. When it has reached the top part of the tube, the cartridge is inclined while it passes through the opening provided between the mountings by bearing on a roller suitably placed for this purpose; it then pivots round the bucket trunnions until it slides by gravity in the trough prepared to receive it. As soon as the cartridge has left the bucket, the bottom end of the latter strikes against a fixed butt, which places it straight again, ready to follow the guide that surrounds the descending chain. The electric motor for working the hoist is joined to the central tube below the armored deck. It works a shaft through an endless screw and a helicoidal wheel that surrounds a set of differential gearing; this drives a shaft arranged to work another spindle placed at the lower end of the tube, and on which are keyed the pinions that drive the hoist. For operating the hoist by hand power it suffices to turn the central shaft by two cranks, the gearing above referred to transmitting the motion.—Engineering.

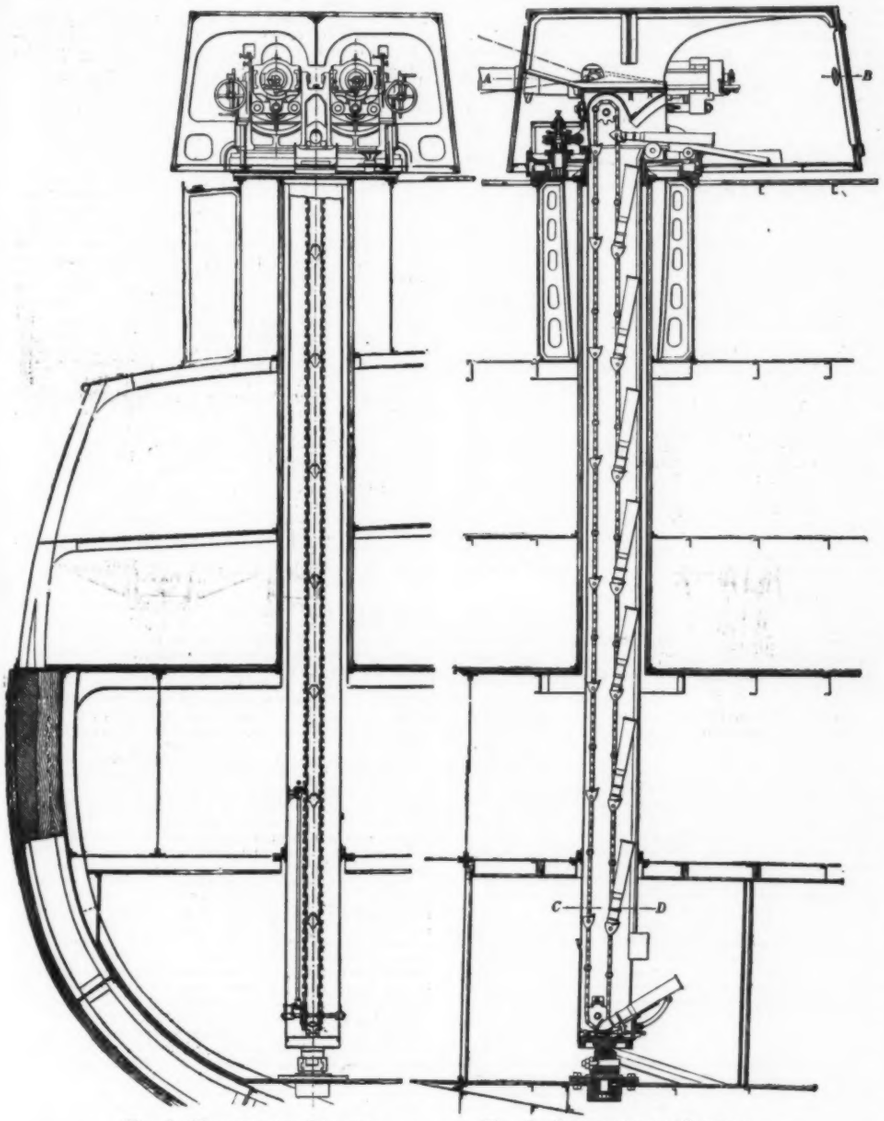


FIG. 4.—TRANSVERSE SECTION. FIG. 5.—LONGITUDINAL SECTION.

SCHNEIDER-CANET ELECTRICALLY WORKED TURRET FOR TWO 12-CM. (4·7-INCH) GUNS.

[Continued from SUPPLEMENT, No. 1258, page 20173.

ABSTRACT OF THE REPORT OF THE COMMITTEE ON CANALS OF NEW YORK STATE.*

III.—PROJECT RECOMMENDED.

IN the foregoing we have given reasons which have led us to the conclusion that it is not wise for the State to abandon its waterway, and that the ship canal will involve an enormous expenditure without producing a satisfactory result. It then remains for us to consider to what extent the waterway across the State should be enlarged. A number of projects have been under consideration, involving plans for a canal of different depths, from 9 to 14 feet, carrying boats with capacities of from 320 to 1,500 tons, and involving an expenditure of from $13,000,000 to $80,000,000. In order to arrive at an intelligent decision, it is necessary to determine with reasonable accuracy what each of the proposed projects will produce in the way of freight rate, and what it will cost.

The Erie Canal was originally built with locks 90 feet long, 15 feet wide and 4 feet deep, and with a prism of corresponding depth. The boats first used carried 30 tons. It has been successively enlarged at different times, as shown on the accompanying diagram. At the end of 1862 it had double locks, 104 feet long, 18 feet wide and 7 feet deep, and carried boats of 240 tons. No improvements have been made during the last thirty-seven years, except to lengthen the locks on one tier so as to pass two boats at one lockage. This work had been completed on all the locks except at the four flights of Cohoes, Little Falls, Newark and Lockport. It was anticipated that at these points modern lift locks would be desirable, and that it was unwise to expend any money in lengthening the locks of the old pattern. This was the condition of the canal at the time of the adoption of the project of 1895 (Chapter 79 of the Laws of 1895). This law describes the project in the following language: "The said improvement to the Erie and Oswego Canals shall consist of deepening the same to a depth of not less than nine feet of water, except over and across aqueducts, miter sills, culverts and other permanent structures, where the depth of water shall be at least eight feet, but the deepening may be performed by raising the banks wherever the same may be practicable; also the lengthening or improving of the locks which now remain to be lengthened, and providing the necessary machinery for drawing boats into the improved locks, and for building vertical stone walls where, in the opinion of the State Engineer and Surveyor and Superintendent of Public Works, it may be necessary. The improvement upon the Champlain Canal shall consist in deepening the said canal to seven feet of water, and the building of such vertical stone walls as in the opinion of the State Engineer and Surveyor and Superintendent of Public Works shall be necessary. The work called for by this act shall be done in accordance with plans, specifications and estimates prepared and approved by the State Engineer and Surveyor."

The contracts let under this project were all upon the prism and none upon the locks (except at locks 21 and 22). The plans and estimates, so far as we can learn, contemplated locks which would provide for the passage of two boats, each 104 feet long, 17½ feet wide and about 7½ feet draught. It was estimated that this would increase the carrying capacity of the boats about one-third, namely, from 240 tons to 320 tons.

This is what we understand to have been the project of 1895.

In his report for 1897, State Engineer Adams recommended the lengthening and deepening of the locks by the use of a different type of gate, so as to provide for boats of 115 feet in length, 17½ feet wide and 8 feet draught. This would increase the carrying capacity of the boats to 400 tons.

In the report of Messrs. North and Cooley, the engineers of the Investigating Committee of 1898, it was pointed out that many items had been omitted in the project of 1895, such as "the strengthening of banks and repairing or renewing of locks, aqueducts, waste weirs, etc.; . . . all locks deepened and lengthened or replaced with pneumatic lifts as at Lockport and Cohoes, . . . and pneumatic lifts at Newark and Little Falls." The carrying out of this additional work necessarily increased the estimates of the engineers of the Investigating Commission beyond those of the State Engineer.

We have considered the cost and value of the original project of 1895 when completed, as well as that including the modifications suggested by Messrs. North and Cooley, and we have also considered the cost of a similar project with locks sufficient to take two boats, each 125 feet in length, 17½ feet in width, 8 feet in draught, with a cargo capacity of 450 tons. We also considered the cost of widening one tier of locks so as to pass boats 125×25×10 feet, with the idea that these boats might be temporarily used on a six-foot draught, and thus derive a partial advantage in the increased cargo and decreased freight rate, pending the final completion of the project. This plan was very favorably received by boatmen and others interested in canal transportation, and this led us to make a very careful examination and test of the accuracy of the estimates of cost which we had used in our circular letter of May 1 as a basis for discussion, and which had been obtained from such published data as was then available. The result of such examination showed that the figures which we had been considering were erroneous. We also caused plans to be made of the sharp bends and other points of the canal where the navigation by boats 25 feet wide pending the enlargement would be difficult, and the result of such examination clearly convinced us that such boats could not be used to advantage until the final completion of the entire project. We also learned that a similar plan of temporarily navigating the canal on a single track basis with turnouts had been tried during the enlargement of 1855 and found to be impracticable. We were therefore compelled to abandon further consideration of the project designated as "Plan 2" in our circular letter of May 1.

We have also considered with some care the project of a barge canal for barges of 12 to 14 feet draught, and capacity of 1,200 to 1,500 tons; but we became convinced that a barge of this size would cost very much

* Plans and cross-sections of the proposed canal accompanied the first part of this report.

more than a barge of 1,000 tons capacity; that the corresponding canal would cost very much more than the canal suitable for the 1,000-ton barge, and that the cost of transportation, or freight rate, would be substantially the same in both cases. We, therefore, have not made any detailed estimate of the cost of a barge canal for 1,500-ton barges.

The result of the investigation, therefore, reduced the number of projects to four; and the cost and economic value of each have been very carefully considered. In considering the three smaller projects, we became convinced that the completion of the project of 1895, as originally designed, and producing a waterway to be used by boats of 320 tons, would produce so slight an improvement over existing conditions as not to justify the expenditure of public money. As between the projects for boats 115 feet or 125 feet in length, each having 17½ feet width and 8 feet draught, we concluded that the increased saving in transportation cost by the larger boat was sufficient to justify the increased expenditure.

We thus eliminated from consideration all of the various projects except two, and the relative advantages of these will be stated in some detail, in order to explain fully why we have finally decided to recommend the larger project.

Each of the projects contemplates that the first work to be done will be that upon the locks, so as to fix the size of the boats, enable builders to resume the building of boats, and pending the completion of the prism to pass three of the present boats at one lockage. There are two points on the canal where an entirely different system of locks sifould be introduced: one at Cohoes, where a double pneumatic or other mechanical lift should replace the existing sixteen locks; and the other at Lockport, where a similar lift should replace the existing five locks. There are two other points, namely, Little Falls, where the four existing locks should be replaced by three new locks; and Newark, where the three existing locks should be replaced by one new lock. At other points the existing locks are to be rebuilt with greater length and greater depth. Each plan also contemplates the use of quadrant gates in place of the present gates, and of mechanical power, either steam or electricity, for operating the gates and for working the boats into and out of the locks.

Each plan also contemplates a new canal for about 100 miles, or 30 per cent. of the entire length. One diversion is from Clyde to New London, following the line of the Seneca and Oneida Rivers and Oneida Lake, avoiding the treacherous foundation which is such a fruitful source of expense across the Montezuma marshes, and giving a wide waterway through the rivers and lake just mentioned, so as largely to increase the speed of the boats. The other diversion is to begin at the West Troy side cut (cutting out two locks and seven miles of canal between that point and Albany), and construct a new canal leaving the Hudson River at the West Troy side cut and following the line of the existing Champlain Canal, and the bed of the Mohawk River to the Cohoes Falls; to canalize the Mohawk River from the Falls to Rexford Flats, near Schenectady, and possibly as far up as Little Falls, if the result of further surveys shall show that this is cheaper than to follow the present route. The canalization of the Mohawk River between Cohoes and Rexford Flats will do away with the two aqueducts, the expense of rebuilding which on either of the plans for enlargement would be very great.

The aqueduct at Rochester and the line of the canal through that city are so located that the expense of enlargement will be almost prohibitive, and we therefore advise the adoption of a new line to the south of Rochester, as is fully set forth in the estimates of the engineers. The adoption of the new line between Clyde and New London would carry the main canal about six miles north of Syracuse, but an outlet is provided for into Onondaga Lake, where large and satisfactory terminal facilities can be provided for the benefit of the Syracuse trade at comparatively small expense.

Our estimates provide for carrying the enlarged canal through the city of Utica on the present route, but further surveys are necessary to show whether it would be cheaper to carry it around the city of Utica.

For many years it has been suggested by engineers that it would be desirable to carry the canal between Clyde and some point in the vicinity of Rome by a southern route which should give a constantly descending canal from Lake Erie to the Hudson River. It has also been suggested that the Syracuse level might be extended east and west, so as to provide a constantly descending canal. These projects were so attractive that we employed Mr. George W. Rafter to ascertain definitely what they would cost. His complete report has been filed with the State Engineer, and we recommend its publication. He surveyed one route to the south of the present line, one to the north, and one intermediate for extending the Syracuse level east and west. His surveys showed that the cost of the southern route, 58 miles in length, would be $29,000,000; the northern route, 58 miles, would cost $22,400,000; and to extend the Syracuse level east and west, 113 miles, would cost fully $32,500,000. These estimates are based on a canal of 12 feet depth, sufficient to carry boats 25 feet wide and 10 feet draught. The adoption of either of these routes would involve a cost of from $17,000,000 to $25,000,000 in excess of the route which we recommend by the Seneca and Oneida Rivers and Oneida Lake. In our judgment, no advantage would be gained corresponding with such an increased cost, and we therefore advise the adoption of the route via Seneca and Oneida Rivers and Oneida Lake.

The route to be followed by either of the two projects which we now submit is therefore the same, and the difference in cost is that which arises from the difference in the size of boats and the difference in the size of locks and prism to carry them. The smaller project is for boats 125 feet in length, 17½ feet in width, and 8 feet draught, and a capacity of 450 tons; and the larger project is for boats 150 feet in length, 25 feet in width, and 10 feet in draught, with a capacity of 1,000 tons. The cost of transportation in one case will be 0·88 of a mill per ton mile, or 1½ cents per bushel of wheat from Buffalo to New York; and in the other case 0·52 of a mill per ton mile, or 0·8 of a cent per bushel of wheat from Buffalo to New York. The cost of transporting a ton of freight from Buffalo to New York by the smaller project will be 44 cents, and by the larger project 26 cents. The smaller canal will have a capacity of 10,000,000 tons per annum, and on that tonnage the saving, as compared with the present canal, will be $4,300,000 per annum; on the same tonnage, the saving by the larger canal will be $6,100,000 per annum, but its capacity would be in excess of 20,000,000 tons per annum, and on that tonnage the saving as compared with the present canal would be $12,200,000 per annum. As compared with the lowest rail rate ever quoted across the State of New York, the saving on a tonnage of 20,000,000 tons per annum would be nearly $18,000,000 per annum.

As between these two projects, the undersigned are unanimously of the opinion that it is best for the State to adopt the larger project. Whether these views will meet the approval of the legislature and the people it is not for us to say. We confine ourselves solely to advising you what in our judgment is the proper policy for the State to pursue in regard to its canals, leaving to those on whom the responsibility rests to decide whether these views should be carried into effect. We feel confident that on mature reflection the legislature and people of the State will ultimately adopt these views. We have hesitated to recommend the expenditure of a sum of money which, although small in proportion to the resources of the State, is still a very great sum; but after much deliberation we are unwilling to recommend any temporary or partial settlement of the canal question. We do not believe that the adoption of the smaller plan will result in permanent benefit to the State of New York, and as the money expended on the smaller project would be almost entirely wasted in case a larger project should be determined upon later on, we do not feel justified in recommending the expenditure of so large a sum as $21,000,000 for a temporary purpose. We feel confident that the larger project will result in a transportation cost across the State of New York as low as that by the St. Lawrence canals, which constitute their chief rival at present, far less than any rate which is possible by railroad at any time within the immediate future, equal substantially to the results which could be obtained by a large barge canal or a ship canal, and, in short, would be a complete and permanent solution of the canal problem. It would give New York advantages in the low cost of transportation, and the commerce resulting therefrom which would be possessed by no other State on the Atlantic Coast.

We believe it is unwise to spend large sums of money in a mere betterment of the existing canal; what the present situation requires is a radical change, both in size and management, and what we recommend is practically the construction of a new canal from Lake Erie to the Hudson River, following the present canal for something over two-thirds of the distance, and new routes for the remaining distance of a little less than one-third, and utilizing the existing structures and prism so far as they can be made use of. We are firmly of the opinion that any less complete solution of the problem will in the end prove to be unsatisfactory; and that while the sum of money required to put this into execution is large, yet the resources of the State of New York are so enormous that the financial burden will be light.

In regard to the Oswego and Champlain canals, we think the project of 1895 will afford an adequate solution, and that this project should be completed. The State has already expended on these two canals since 1895, $2,841,600. The cost of completing them now, owing to the Eight Hour Law and the increased price of materials, will be as follows:

For the Oswego Canal*.....	$818,120
For the Champlain Canal.....	1,824,000
Total.....	$2,642,120

We have carefully considered the substitution of the Hudson River for the Champlain Canal between Fort Edward and West Troy, but we find that this will add about $2,000,000 to the cost, and we do not think that the benefits will justify this additional expense. Subsequent surveys may show that for a portion of the distance it may be possible to utilize the Hudson River at a smaller expense than the estimates we submit for the corresponding portion of the canal.

The completion of this project will give a prism of nine feet depth and structures with eight feet depth of water on the Oswego Canal, making it suitable for boats of 330 tons capacity; and on the Champlain Canal will provide a prism of seven feet in depth, with six feet of water over structures, capable of transporting boats of 240 tons.

IV.—FINANCES.

Much has been said at various times about "the burden of taxation" for canal improvements and canal expenses, which, in our judgment, is not warranted by the facts; and it seems to us desirable that there should be a clear understanding of the matter. Elsewhere we have given itemized statements, compiled from the records of the public offices at Albany, showing for each of the canals in this State the revenues received, and the cost of construction, enlargement, operation and management from their inception to the close of the year 1898. This statement shows that the minor canals have resulted in financial loss, and several of them have not even paid any appreciable return upon the sum expended in their construction. Several of the latter, such as the Genesee Valley, Chenango and Chemung canals, were abandoned some years since, and it must be frankly admitted that their construction proved to be a mistake, and the sums expended on them were a total loss.

As to the Erie, however, the reverse is the case. Down to the close of the year 1882, at which time the tolls were abolished, the revenues collected on this canal exceeded all sums paid out upon it for any purpose whatsoever by the sum of $42,599,718. This profit has been reduced in subsequent years by the expenses for ordinary and extraordinary repairs, maintenance and operation, and for enlargement under the Nine Million Dollar Act, and against this outgo for expenses there has been no income from tolls; so that the net balance to the credit of the Erie Canal is now a little more than $20,000,000.

It is important that this fact should always be borne in mind, that the Erie Canal has paid into the State more money by many millions of dollars than has been spent upon it in the aggregate for any and all purposes whatsoever. Were this not the fact, we should not advise its enlargement.

In considering the question of how the canal enlargement should be paid for, we have made a careful study of the assessed valuation of the different counties in the State. A glance at these statistics shows that the wealth of the State lies contiguous to its water routes, the river and canal counties containing 90 per cent. of the total valuation. Statistics are not available which would enable us to make a comparison of the relative wealth of the different counties 80 years ago, prior to the construction of the canals; but we feel confident that these would not show any such great difference as now exists. While the canals have benefited the entire State, and every part of it, yet in those counties lying remote from the water routes the benefit has been less evident than in those adjacent to these routes. It has, therefore, seemed to us that it would be equitable that the expenses of completing the enlargement of the water routes should be borne by those counties through which these routes pass, instead of being paid by the entire State, as has been usually the custom hitherto.

The financial burden, in any case, will not be a large one, for while the sum of $62,000,000, which is the cost of the plans we advocate, is a very great sum of money, yet it is less than 1½ per cent. of the assessed valuation of the canal counties, and a still smaller proportion of their actual value. The assessed valuation of those counties in 1898 was $4,412,772,343. The normal increase in valuation during the last 60 years has been at the rate of a little more than 4 per cent. per annum, or doubling every 23 years. Should this rate continue until 1920, when the bonds would mature, the valuation of the canal counties would then be almost $9,000,000,000.

The population in the canal counties is about 80 per cent. of the entire population of the State; the vote cast in such counties in 1898 was 80·5 per cent. of the total vote. The question of authorizing canal improvements and issuing bonds to defray the cost must be submitted to all the voters in the State; but if the act which is submitted for their adoption or rejection distinctly provides that the taxes to pay interest and principal of these bonds shall be levied in the canal counties only, then it is fair to assume that in the non-canal counties the voters will be indifferent to the question and the vote will be small; so that the canal counties will virtually decide the question for themselves. The Constitution requires money for canal improvements to be raised by bonds maturing in 18 years. They could probably be placed at par, or at a premium, with 3 per cent. interest. The interest and sinking fund to redeem the bonds in eighteen years amount together to $7,271 for each $100,000 of bonds. For $62,000,000 of bonds this would amount to $4,508,020 per annum, which, levied on $4,412,772,343 of assessed valuation in the canal counties, would amount to a little more than 10 cents per $100 of present assessed value, and this would decrease year by year as the valuation increases. The aggregate State, county and municipal taxes in the canal counties now average about $2 per $100 valuation. To increase this from $2 to $2.10 will certainly not prove a serious burden to any taxpayer. To the person or corporation paying taxes on $1,000,000 of assessed valuation it would increase his tax bill from $20,000 to $21,022 per annum; to the man owning a $50,000 house in New York city or Buffalo it would increase his taxes from $1,000 to $1,051 per annum; and to the farmer with a farm valued at $5,000 it would increase his taxes from $100 to $105.11.

If the enlargement of the Erie Canal will restore to New York its former proportion of the grain trade, and in addition will develop the iron and steel industry within its own borders; in a word, will permanently establish the commercial supremacy of New York, which is now not only threatened but partially lost, the foregoing sums are a small amount to pay to bring about such results.

The State adopted and pursued for over 45 years the policy of expending as much as 3 to 4 per cent. of its total wealth on the canals. Such a policy at the present time would involve an expenditure of $150,000,000 to $200,000,000. No such sums, in our judgment, are now proper or necessary, but we cite these figures to show what financial responsibilities have been assumed by the State in reference to its canals in the past, and how small, comparatively, is the responsibility which we now recommend the canal counties to assume. In the past, the outlay, so far as it related to the Erie Canal, was more than repaid in tolls, without taking into account the enormous incidental advantages derived from that canal. If it should ever be thought wise to restore the tolls, similar results can be produced in the future; but if the constitutional prohibition of tolls continues in force, then the burden on the taxpayers in the canal counties will still be comparatively slight in proportion to the enormous aggregation of their wealth.

The heaviest part of the cost must in any event fall on the city of New York as now constituted. This pays about 62 per cent. of all the taxes in the State, and would pay 69 per cent. of the assessment on the canal counties. In other words, New York city would have to pay about $3,250,000 per annum from say 1902 to 1920, in order to establish its commerce on a basis where it would be secure for a full generation, if not for all time, from the injury which has been done to it by its rivals during the last few years. New York city is now considering the propriety of expending between $70,000,000 and $80,000,000 for railroads, bridges and tunnels designed to facilitate the movement of passengers within its limits. It may well consider the propriety of making a sufficient expenditure to secure its commerce, in order to be sure that it will have the passengers to transport.

V.—MANAGEMENT.

As stated in the beginning of this report, in our judgment the efficiency of the canals depends quite as much upon the way the business is handled on them as upon their physical size, and we advise against the expenditure of any more money for their enlargement unless it shall be accompanied with measures which

* The work on the Oswego Canal between Syracuse and Phœnix is provided for as part of the Erie Canal enlargement.

will lead to the adoption of more modern methods in conducting the business of water transportation across the State. The policy of the State hitherto has been to discourage the adoption of modern business methods and to foster the handling of the traffic by canal boatmen owning each a single boat, or small companies owning a few boats. This prevents the State from taking advantage of those improvements in business management which have brought about such enormous economies in other lines. Canal legislation has been largely in the interest of the comparatively small number of canal boatmen, but it has resulted in failure so far as they are concerned, for experience has shown that they are unable to cope with the methods employed through corporate action.

The statistics which accompany this report show that in 1868 the canals carried 44 per cent. of the tonnage across the State, and in 1898 only 5 per cent. In the matter of grain (including flour) in 1868 the canals carried 76 per cent., and in 1898, 10 per cent. Yet during all of these 30 years, the rail rate has always been in excess of the canal rate. There must be a reason why shippers and merchants are willing to pay more for transporting grain and other articles by rail than by canal, and the reason is chiefly because the railroad conducts the business according to modern methods, and the canals do not. There is, in our judgment, no reason why the same business methods cannot be applied to the canals as to the railroads; and if they are applied, they will produce an equally satisfactory bill of lading, equal certainty in the time of delivery and equal responsibility on the part of the carrier.

In order to accomplish this, so much of chapter 934 of the laws of 1896 as limits the amount of capital which shall be employed in the business of canal transportation should be repealed. This law reads as follows: "No corporation organized under this act, and designed to navigate any of the canals of the State, shall have a capital stock exceeding $50,000." It has been charged on the one hand that this law was passed at the instance of the railroads in order to destroy the usefulness of the canals; and, on the other hand, it is asserted that it was passed for the benefit of the boatmen in order to prevent the formation of large corporations, which, by greater economy, could first drive the small boatmen out of the business, and then by some alliance or understanding with the railroads, increase the rates. Whatever the origin of the law may have been, it has proved in practice to be of no benefit to the boatmen. Their business has continued to diminish and to grow still less profitable year by year since this law was passed. They do not make living wages under existing conditions, and they cannot. They are attempting to maintain an antiquated method of business in competition with the modern methods which have brought about the extraordinary increase of wealth during the last 30 years. They cannot possibly succeed, and the State is not justified in expending any more public money unless the conditions are so changed as to derive the full benefit from its investment.

We therefore recommend in the most positive terms that the above quoted law of 1896 be repealed.

The next step is the reduction of terminal charges at Buffalo and New York. The improvements which we recommend are designed to produce a freight rate not to exceed one cent per bushel from Buffalo to New York. The prevailing rate on the lakes from Chicago to Buffalo during the last few years has been 1½ cents, making a total of 2½ cents for transportation alone for a distance of 1,500 miles. The cost of handling at Buffalo and New York is 2⅛ cents, made up as follows:

		Cents.
Elevator charges at Buffalo		.625
Receiving, weighing and discharging at New York	$6.25 per 1,000 bu.	
Canal boat trimming	1.50 " " "	
Ocean vessel trimming	2.00 " " "	
Floating elevator	5.00 " " "	
	$14.75	1.475
Total for rehandling		2.100

We think that the cost of rehandling is out of proportion to the cost of transportation. It is equivalent to 78 cents per ton. Ore and coal are handled at terminal points on the lakes, in large quantities, at a cost of 8 to 10 cents per ton. We believe that the grain can be handled at a cost per ton little, if any, in excess of ore and coal.

Within the limits of the present city of New York and within the new harbor of Buffalo, there are miles of unoccupied and cheap water front where suitable structures and appliances for handling the grain out of the lake steamer into the canal boat at Buffalo and out of the canal boat into the seagoing vessel at New York can be erected, the result of which will produce a reduction in the grain rate fully equal to that which can be produced by an enlargement of the canal. If the elevator charges are not voluntarily reduced, then, with a waterway enlarged and made free as we recommend, the grain will be sent through from Chicago to New York in a fleet of four or six barges (133,000 or 200,000 bushels) without breaking bulk. This, combined with the Montreal competition, will soon force the adoption of improved and cheaper methods of rehandling.

We do not believe that it is necessary to attempt to bring about these results by legislation. If the use of the canal is made free, without restriction as to amount of capital employed, these results will be brought about in the natural course of trade and competition.

Again referring to the iron trade and the marvelously cheap cost of transporting ore, we find that this business is managed by large concerns owning their own mines, their own lake vessels, and their own railroad from the lake port to Pittsburg. At the points where bulk has to be broken, modern mechanical devices are installed for handling the material out of one carrier and into another in enormous quantities and at a minimum cost. We believe that, if the canal is enlarged and made free, analogous methods will be introduced in the grain trade under which responsible companies with adequate capital will take charge of the grain at Chicago or Duluth and deliver it in the hold of the sea-going vessel at New York, making use at all points of the line of their own property in lake steamers, elevators (both movable and floating), canal boats, and tow boats, and giving one through bill of lading. Such companies, it is hardly necessary to say, would not tolerate the antiquated method of hauling canal boats by horses or mules; self-interest would prompt and compel them in a very short time to find the best means of mechanical traction, whether by steam or electricity, whether to have the motive power in each boat, or to have a self-propelled boat which carries freight as well as tows other boats, or to have the motive power in a boat which carries no freight, but is used only for towing. The cost and methods of traction would be studied by such a transportation line with the same care that railroads now study improvements in locomotives, and the result would be constant improvements in the method of traction similar to those which have been in progress on the railroads for the last 30 years, and have resulted in the low rates which have practically driven the old-fashioned canal boat and methods out of the contest. Such a transportation line with such appliances would be able to run boats through the canals on schedule time, and with a more certain adherence to their schedule than the railroads make with their freight trains. It is well known that the schedule time of the lake steamers is far more certain than that of the freight trains on the railroads paralleling the lakes.

The canal boats ought to be able to make at least 4 miles an hour, including lockage, night and day, which would bring the time from Buffalo to New York down to 126 hours, or 5¼ days, in place of about 12 days, as at present.

The other points where we think the canal management is open to great improvement relate to matters entirely within the control of the State, namely, the kind of locks, and the method of handling the locks; the efficiency of the force engaged in the engineering and management of the canals; and the method of carrying on public works by contract. On these points we think legislation is desirable, as well as a more business-like enforcement of the laws, than has hitherto prevailed.

In regard to the locks, we have explained on a previous page the modern arrangement which we think should be introduced at Cohoes, Little Falls, Newark and Lockport, which will reduce the total number of locks from 72 to 54; this will save at least 8 hours in the time of passage, and will dispense with the services of a great number of lock tenders. At the remaining locks it is possible to use an improved modern type of gate, occupying much less space than the old-fashioned gate, invented about 400 years ago, and to operate these gates by mechanical power at a still further reduction in the expense for management.

In regard to the force engaged upon the canals and other public works of the State, the State Constitution (article 5) provides for a State Engineer and a Superintendent of Public Works, and defines their duties. It is impossible to change the Constitution in this respect, if it were desired. In point of fact, the only serious objection we see to the system is that these officers have equal powers and responsibilities, and neither is subject to the other. So long as they work in harmony all goes well, but if they see fit to antagonize each other there is an opportunity for a deadlock, and delay and confusion in the transaction of public business. The system cannot, however, be changed in any reasonable time, and must be accepted. Except in the matter of their having co-ordinate powers, it is not different from the system pursued by railway, steamship, or any other transportation lines, in every one of which there is a manager or superintendent at the head of the operating department, and a chief engineer to supervise the engineering work. The Constitution provides that the State Engineer shall be elected by the people for a term of two years, and the Superintendent of Public Works appointed by the Governor for the period of the latter's term. It is not possible to amend the Constitution in these respects, and it is therefore useless to discuss any other method. That prescribed by the Constitution must be followed, and the people or Governor must be relied upon to put competent men in these places.

The Constitution further provides that the Superintendent of Public Works shall appoint not more than three assistant superintendents, and that he shall appoint all persons employed in the care and management of the canals, except collectors of tolls and those in the Department of the State Engineer, and that all his appointees shall be subject to suspension or removal by him. The Legislature, however, has power to prescribe the duties of his assistants, and to fix their compensation. As to the employes under the State Engineer, the Constitution is silent.

If the Erie Canal is enlarged in the manner we recommend, and becomes again a large factor in the transportation question in this State, the work in its two departments of engineering and management, as well as the minor public works of the State, will afford a life career to the graduates of scientific institutions which they would gladly enter if they could feel sure that their tenure of office depended on good behavior, their promotion upon merit, and that they were not liable to be turned out at any moment for some political reason. While the Constitution places in the hands of the Superintendent of Public Works the power of appointment and removal in his department, yet the law has already restricted his absolute power in the matter of appointments by prescribing examinations and tests of fitness which must be passed before he can make the appointment; and similarly, the Legislature can restrict his power of removal so as to limit it to removal for cause.*

Finally, we think that the laws in regard to the letting of public contracts by the State can and should be revised so as to make impossible a repetition of the unfortunate results under the nine million dollar appropriation. These results, under the present law, were unfortunate in the following respects: An unnecessary expenditure for advertising; a loss of public money through unbalanced bids; and an unnecessary expenditure through the use of force account. The report of the Investigating Committee appointed by Governor Black fully pointed out these facts, and it only remains for us to suggest such legislation as in our opinion would prevent them from occurring again.

In the matter of advertising, Chapter 794 of the Laws of 1896 required the work to be advertised in the State paper for ten successive days, and in such other newspapers as the Superintendent of Public Works may select. We recommend that this be repealed, and in place thereof a statute be enacted similar to the statute now in force in the city of New York (Section 66 of the Consolidation act), under which all advertising for the State shall be confined to the State paper, but allowing brief advertisements, calling attention to any contracts intended to be awarded and referring for full information to the said State paper, to be published in not exceeding two newspapers in each of the ten principal cities in the State.

In regard to the use of force account and extra work, we recommend that a statute be enacted providing that extra work shall be authorized only by the authority of the State Engineer and the Superintendent of Public Works, expressed in writing, and in no case shall such extra work (including force account) be authorized to an extent in the aggregate exceeding 10 per cent. of the value of the contract as determined by the bidding sheets.

We also recommend that the statute require that the bids shall not only be opened in the presence of bidders, but shall be publicly read in their presence; which, as stated in the report of the Investigating Committee appointed by Governor Black, was not done.

As to unbalanced bids, they have been used upon the Erie Canal for a great many years. They were brought out in the Tilden investigation, and they were again shown up in the report of the Investigating Committee of 1898. The State has lost large sums of money from this cause, and there will probably be the same trouble in any future canal work unless some different system of bidding is adopted. We recommend for adoption, by statute, the following system, which is not novel, but is based upon methods which have been in use on large public works in other countries for more than a generation. The proposed method is as follows: Prior to the letting of any public contract the Division Engineer to prepare a schedule of prices for every unit of work to be used under the proposed contract. This schedule of prices to be submitted to the State Engineer and the Superintendent of Public Works for approval or revision, and when approved by them to be submitted to the Canal Board for final adoption. On the letting of the work, each bidder will only be required to bid a discount or premium of a certain per cent. on the prices adopted by the Canal Board. The lowest bidder will be the one offering the greatest percentage of discount or the least percentage of premium on these prices. All questions of quantities will be eliminated from the bidding. It is fair to presume that prices which have been originally drawn up by the Division Engineer, familiar with all the local conditions, subsequently revised and approved by the State Engineer and the Superintendent of Public Works, and finally adopted by the Canal Board (which should have authority to call in outside expert advice, if it saw proper), would be fair and reasonable prices for the work to be done. It would then only remain for the bidder to use his own judgment as to increasing or diminishing these prices by a certain fixed percentage, which should apply to every item in the entire list.

The schedule of prices taken from a contract made on this plan is submitted herewith, showing how fully every unit of possible work can be provided for. We believe that the adoption of such a plan as a part of the law of this State would make it impossible hereafter for contractors to take advantage of the State by means of unbalanced bids.

In closing this report we desire to put on record our appreciation of the ability shown by John A. Fairlie, Ph.D., secretary of the committee, in compiling and arranging under its supervision the statistical data which is hereto appended. In these tables will be found, we believe, the essential facts and figures which are necessary for any consideration and satisfactory solution of the canal problem, and which, so far as we know, have never before been brought together in a single volume.

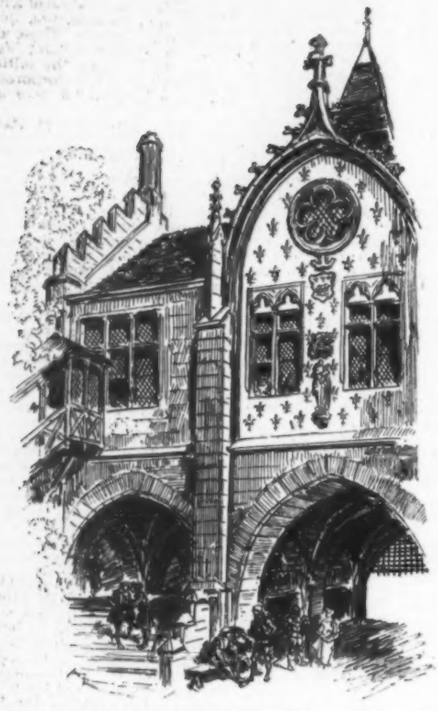
Trusting that the result of our labors during the past year may be of some assistance in enabling you and the Legislature to "formulate definitely the canal policy of the State"—a matter which we consider of vital importance to its commercial and industrial welfare—we remain, very respectfully,

FRANCIS V. GREENE, Chairman.
GEORGE E. GREEN.
JOHN N. SCATCHERD.
THOMAS W. SYMONS.
FRANK S. WITHERBEE.
EDWARD A. BOND.
State Engineer and Surveyor.
JOHN N. PARTRIDGE,
Superintendent of Public Works.

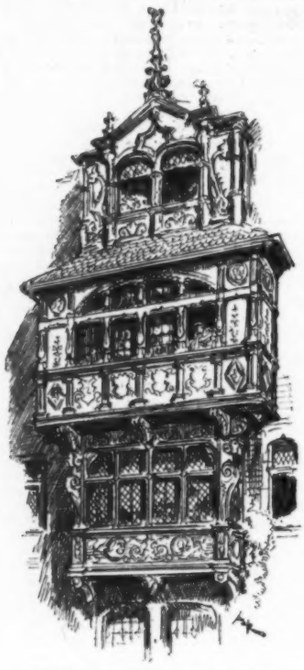
* See decision of Court of Appeals, People ex rel McClelland vs. Roberts, 148 N. Y., 360.

FOREST FIRES.

THE actual cash damage done by forest fires is hard to estimate. A commission has recently been appointed to make a canvass, and has reported that in the last twenty years in the territory of the United States and the land in British North America the damage has footed up $800,000,000. In the one year of 1880 a territory was burned which comprised at least 10,250,000 acres. The value of the forests alone was $25,000,000. And the year chosen was not one particularly noted for the frequency of its fires. In the West, where a thick growth of trees, a long dry season and the reckless prodigality of the inhabitants make a combination favorable to large losses, the damage is wonderful. The smoke from the frequent fires is so thick that it renders the navigation of Puget Sound dangerous. Thirty million dollars' worth of stumpage has been burned in one part of the State of Washington. During the year 1898 the number of fires was exceptionally large, and, though the reports of the damage are not yet all in, there is sure to have been a loss of property footing up millions and millions of dollars. From the time of the occupation of the Indians to the present day there has been a succession of these forest fires. It is a question how to deal with them. Many States have forest laws, but they are not well enforced. The fruits of the carelessness and waste of the early settlers are now being gathered by their descendants. Many men are needed to combat a fire, and the most earnest



GUARD-HOUSE ON PLACE PRÉ-AUX-CLERCS.



RENAISSANCE BRETESSE.

TOWER OF THE LOUVRE AND THE MAISON AUX PILIERS.

co-operation is necessary for satisfactory results. The danger from this source does not seem to be decreasing, and when we think of so powerful a factor for evil, moving at a speed sufficient to overtake a horse on the gallop, it will be seen that prompt measures are necessary to protect what remains of our once proud and still extensive forests. There has been a very long season of dry weather lately, so dry that the marshes on the lakes were on fire at one time. The appointment of fire marshals is not enough. They must be given power to compel services, and a tax for the special purpose of reimbursing burned-out settlers and the bringing of any culprits to justice might be instituted. If something is not done we shall have the mortification of seeing our forests disappear beyond recall. It is extremely difficult to get anything but approximate figures concerning the number of deaths resulting from forest fires, but isolated paragraphs tell something of the story. During the terrible fires of 1894, when millions of feet of lumber burned, the town of Hinckley lost over 200 souls of its population. In 1871, a year made so memorable by its great conflagrations, the loss of life from the towns on the west shore of Lake Huron was over 5,000, and this territory was a mere tithe of the burned-over country. In the Minnesota fires of four years ago the villages lying on a line between Carlton and Pine City, where the flames took their course, in 130 miles of territory over twenty towns were wiped out, and in Carlton and Pine counties alone the loss of life was over 1,000 persons. If one considers that these figures come from small tracts and that they are from but one fire, while millions of acres are burned over every year, and the fires have been doing their work since America has been in existence, some idea of the awful loss of life may be approximated. It is safe to say that fire in the forests has been responsible for the deaths of millions of people.—Detroit Free Press.

OLD PARIS AT THE EXPOSITION OF 1900.

IT is perhaps not generally known that the site of "Old Paris," now under construction for the Exposition of 1900, on the right bank of the Seine, possesses a most interesting history. In the middle ages it was a willow-grown bank below the village of Nigeon, later on called Chaillot, the principal street and the church of which were to be seen at a short distance behind sloping gardens. Chaillot, and, consequently, Old Paris, was then the suzerainty of the abbey of Saint-Martin-des-Champs. Later on, Chaillot belonged in part to the Seigneur of Marly-le-Roy, and in part to Messire Philippe de Commines, who owned there a square tower and a mansion. After the massacre of St. Bartholomew, a large portion of the corpses dumped into the Seine by rubbish carts were stranded among the willows of Chaillot and accumulated in the bend of the Seine where now stand the structures of Old Paris. An embankment of stone had been begun during this same year in order to prevent the river from encroaching upon the pasture grounds of Chaillot; and, later on, the seigniory having passed into the hands of the Marshal of Bassompiere, this work was resumed and completed. This quay wall of wide stones has recently been found under the dry wall of the bank at the upstream portion of Old Paris.

As an entrance to Old Paris, in front of the Palais des Congrès of the Alma bridge, selection has been made of one of the gates of the old wall upon the left bank—the Saint Michel gate, the extremity of the great thoroughfare of Paris through Rue Saint-Denis,

PLACE DU PRE-AUX-CLERCS.

TRADESMEN'S STALLS AND SHOPS BACK OF THE APSE OF THE CHURCH OF SAINT-JULIEN-DES-MENETRIERS.

the Pont-au-Change, the Pont-Saint-Michel and Rue de la Harpe.

In front of the Alma bridge, we have the high, turret-flanked pavilion of the Saint Michel gate, a fragment of a rampart, a corner tower, and the remains of earlier fortifications upon which, in the course of ages, houses have been built. Beyond the entrance arch, we find ourselves in a court overtowered by one of the turrets of the old Louvre, which thrusts

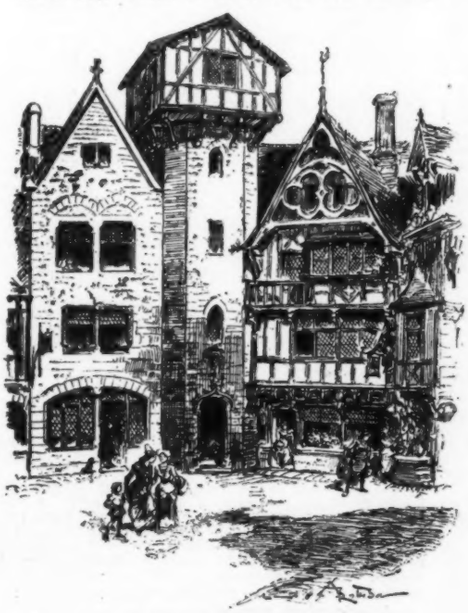
SAINT-JULIEN-DES-MENETRIERS CROSSWAY.

its weather-vane-crowned spire 130 feet into the air. This is typical of the tall Parisian towers that were built all after the same style, in the time of Charles V. Such were, for the Louvre, the corner towers of the castle properly so called. The windows formed in the tower of the Louvre of Old Paris are those of the magnificent staircase constructed in the great tower by Charles V.

Alongside of this memorial of the Louvre of the kings stands a fragment of the bourgeois and popular Louvre, the first town hall of Paris, consisting of one of the gables of the Maison aux Piliers, purchased by the city in 1357 in order to replace the old Parloirs aux Bourgeois. The Maison aux Piliers, a building of the 14th century, the embryo of the present immense city hall, had three gables supported by pillars, and forming a gallery upon the famous square that has seen so many events, so many seditions, so many fêtes, and so many dramas.

From this first square of Old Paris, called Place du Pré-aux-Clercs, start two streets—the Rue des Vieilles-Ecoles, to the left, which, further along, opens out more widely upon the Seine, and the Rue des Remparts, to the right, shaded by the old trees growing upon the site.

Let us take a walk in the Rue des Vieilles-Écoles,



RUE DES VIEILLES-ÉCOLES.

HOUSE OF ROBERT ESTIENNE; TOWER OF FORTET COLLEGE; HOUSE OF THEOPHRASTE RENAUDOT.

among the gables of wood and stone standing close together. First, we find one that exactly reproduces the house in which Molière was born; the true house—not the one of Rue de la Tonnellerie in which he lived as a child, after Master Poquelin, his father, had moved thither his upholstery shop, but the one of Rue des Etuvas-Saint-Honoré, where the upholsterer established his business at the sign of the "Pavillon des Cinges."

The structure alongside is another house of a celebrated Parisian, which still exists at 45 Rue de Montmorency, but totally disfigured. It is here restored from drawings of the last century. Its owner, Nicolas Flamel, who, according to tradition, was an illuminator, and a somewhat mysterious savant and alchemist, would easily recognize it. It was constructed in 1407.

Flamel represented the art of rubric penmanship and miniature painting of the middle ages at its most brilliant period. The two neighboring houses show us, first, the new art of typography preparing to send throughout the world its beautiful 16th century books with figures upon wood; and then the Press and the Newspaper, the immense power of modern times in the cradle of its infancy. The two houses in the vicinity of that of the illuminator are those of Robert Estienne at the sign of "L'Olivier," and Theophraste Renaudot at that of "Au Grand Coq." We are at

SAINT-MICHEL GATE—FAÇADE UPON THE SEINE.

Estienne's house a few years before King Francis, the father of letters, came thither to visit the master printer; but the old hand press, the old typographical furniture and the old uncorrected proofs hanging by a string are still there.

Theophraste Renaudot, in his house of the "Grand Coq," Rue de Calande, near the Palace, founded a free medical and pharmaceutical dispensary, a bureau of addresses and offers and wants, and, in 1637, the Gazette, the Mother Gigogne of an innumerable and noisy posterity. A turret built with a staircase stands by the side of the Renaudot house. It is a turret such

COURT OF SAINTE-CHAPELLE—PALACE BUILDING WITH EXTERNAL STAIRWAY.

as the old colleges of the University were provided with at one side of their building.

Next come the Grand Logis, a mansion of some rich bourgeois, some houses of less importance, and a group of shops and covered stalls in the rear of the apse of the church of Old Paris. This church, which is picturesque by reason of its architecture, is the Saint-Julien-des-Ménétriers, a church of the fraternity of the Minstrel Jongleurs, later on of the Corporation of Musicians, of the Society of Players upon Instruments, and of the ancient Society of Dancing Masters. These are some of its titles. Founded in Grand'rue Saint Martin in the middle of the 16th century, upon the initiative of two minstrels, with the savings of the Corporation, the church was completed as a hospital for poor strolling jongleurs.

The purely middle age quarter of Old Paris ends here at the Carrefour Saint-Julien, where ends also the Rue des Remparts, which is skirted by other houses and shops. Old Paris is not to be a dead city, for all the houses will be occupied from top to bottom, and all the inhabitants thereof will be clad in the costumes of their trade and of their epoch. The gates, moreover, will be guarded by a troop of royal archers wearing upon their hacquetons the arms of the city.

But, to come back to an account of the buildings: Behind the public pillory, which is situated at a few steps from Saint-Julien, stands the Great Halles building. The trusses of the framework of this have a span of over 80 feet, and large irregular dormer windows in each truss add further picturesqueness to the hall, in which musical performances, under the direction of Colonne, will alternate with presentations of all the famous pieces of every nature.

In front of the down-stream front of the Halles is

situated the arched entrance to the Chatelet, which is capped by the belfry of its little chapel. The archway of the Chatelet gives access to the Pont-au-Change. We are here in the 17th century, under Louis XIII. Through the Pont-au-Change, it has been the desire to give an idea of those house-bridges of ancient times that formed, in the first place, streets with irregular houses placed projectingly upon the girders or stones of the bridge, over mills revolving from arch to arch, and afterward, starting from the 18th century, converted into streets with symmetrical structures all alike. It is a Renaissance bridge of this kind that has been reproduced in part, with its shops of various kinds. Below and behind this bridge, between the Halles and the Palace, a corner has been reserved for an arrangement of small shops of the 18th century. At the down-stream extremity of Old Paris, which is connected with the foot bridge that extends between the Champ de Mars and the Quai de Billy, the Palace constitutes a collection of structures of large dimensions, the tallest one of which is the building that reproduces one of the bays of the Grande Salle du Palais, that existed all through the middle ages and did not disappear until the last century. After following the passageways under the Grande Salle, we find ourselves in what is called the Court of the Sainte Chapelle, which is located upon one side of the Seine. In this court, which, like Pont-au-Change, is situated at 16½ feet above the platform of Old Paris, we observe against the façade of the large building of the Palace the great stairway of Sainte-Chapelle constructed by Louis XII. opposite the Cour des Comptes. This outside flight of steps is reproduced in its entirety, along with its four arcades, its pillars ornamented with fleurs-de-lis, and its tradesmen's stalls built along to the line of the stairway.

Upon the façade fronting the Seine there is another historic souvenir, which recalls the Hotel de Bourbon, that very vast and very celebrated feudal edifice which occupied nearly the entire ground between the Louvre and the Pont-Neuf. Its decadence began at the time of the treason of the Constable of Bourbon, when King Francis I. dismantled its turrets and painted its façade yellow as a sign of infamy. Of this mansion we represent the beautiful Renaissance window of the 14th century, upon which, in the cinquefoil arches of the gallery, are inscribed the letters of the word "Esperance," the eternal device of all princes of the blood who are too near the throne.

For the above particulars and the engravings, we are indebted to Le Monde Moderne.

EFFECT OF HEAT ON BABBITT METAL.

ALMOST any solid metal for lining bearings is called by the name "babbitt metal," while in fact few of the soft linings used have any claim whatever to that title, says Modern Machinery. The genuine alloy which was compounded by John Babbitt, and which bears his name, is composed of eight parts regulus of antimony (regulus means the pure, refined metal), four parts copper and ninety-six parts of tin.

Ordinary soft lining, so-called babbitt metal, frequently is made up of four parts lead and one part antimony. Old type metal is also used for lining, and consists of two parts lead, one part tin, and one part antimony. Britannia metal (pewter) is much used for lining, and this consists of nine parts tin and one part antimony.

It will be noted that all the alloys above described are partly of antimony, and also contain either lead or tin, both easily oxidized metals. But antimony is even more easily oxidized, and will burn in the open air if too highly heated, much like zinc. Thus, when either of the alloys described above is frequently heated, the different metals become oxidized, but burn out in different ratios to each other, thereby changing the nature of the alloy to a certain extent each time it is heated.

Genuine babbitt will probably change its form more by reheating than the alloys of antimony and lead, but the latter are reduced the most in quantity. The reason, therefore, is that the copper and tin oxidized more slowly than the antimony, which quickly burns out, leaving the babbitt much softer than it was before getting rid of some of its antimony. Lead oxidizes much more freely than either copper or tin, therefore the alloy retains more nearly its original composition when a quantity is burned off or oxidized; still the antimony burns out faster than the lead, reducing the hardness of the alloy, but not to the extent it does when mixed with tin and copper. Under proper conditions any kind of babbitt metal may be melted, and even kept indefinitely in a molten condition without oxidation, or, in every-day language, without the forming of dross on the surface of the molten metal. To secure this result, protect the metal from the atmosphere. A layer of dirt on top of the molten metal will do it; even a layer of oxide or dross is a good preventive; therefore do not skim off the layer of oxide as fast as it forms, but let it stay on top of the hot metal.

A very good way is to cover the metal in the ladle or melting pot with pulverized charcoal. Carbon largely retards the process of oxidation, and if some salt and soda (common washing and cooking soda) be added to the coarsely-powdered charcoal, the oxide will be reduced—that is, the dross will be smelted back into the metal again.

Another preventive of oxidation of babbitt metal lies in not heating the metal too hot. For all except very small bearings, where the layer of metal must run very thin, there is no need of heating the metal very hot. Just hot enough to barely char a dry pine stick is a good rule to follow when heating babbitt metal. But whittle the stick every time the metal is tested, so that a fresh wooden surface is exposed thereto.

Proposed Free Port at Rotterdam.—Consul Hill, of Amsterdam, on December 21, 1899, writes that in the course of January there will be presented for sale, through Mr. A. Loeb, of the banking house of Mendes, Gans & Company, grounds situated in the immediate neighborhood of Rotterdam, near deep water and railway. Here there can be established a free port territory, which will present very good prospects and will be in a more favorable position even than the free harbors of Bremen and Hamburg, on account of the geographical position and the lower wages it would be necessary to pay.

TRADE NOTES AND RECEIPTS.

Polishing Bricks.—Stir into a thick pulp with water 10 kilos of finely powdered and washed chalk, 1 kilo of English red and 2 kilos of powdered gypsum; give it a square shape and dry.—Neueste Erfindungen und Erfahrungen.

To Tell Genuine Meerschaum. — The Praktischer Wegweiser publishes the following test for meerschaum: For the purpose of distinguishing imitation meerschaum from the true article, take silver and rub same with it. If the silver leaves lead pencil-like marks on the mass, it is not genuine but artificial meerschaum. If no such lines are produced, the article is genuine.

Bleaching of Bath Sponges.—The bleaching of bath sponges to improve their appearance is effected with potassium dichromate. A pale yellow color is characteristic of such sponges, but a quantity of chromates remaining therein is risky. Gawalowsky considers a bleaching by immersion in a 10 per cent. calcium bisulphite solution more appropriate, because such sponges are fit for all surgical and cosmetic purposes, though of a paler appearance.—Neueste Erfindungen und Erfahrungen.

Liquid Indelible Drawing Ink.—Dissolve, by boiling, 2 kilos of blond (golden yellow) shellac in 1·6 kilos of sal-ammoniac 16°, with 10 liters of distilled water, and filter the solution through a woolen cloth. Now dissolve or grind 0·5 kilo of shellac solution with 0·01 kilo of carbon black. Also dissolve 30 grammes of nigrosine in 400 grammes of distilled water and pour both solutions together. The mixture is allowed to settle for two days and the ready ink is drawn off from the sediment.—Deutsche Maler Zeitung.

Production of Leather Cement.—In a firm glass balloon dissolve in 5 kilos of carbon sulphide and 10 kilos of oil of turpentine, cold, 2 kilos of finely cut-up gutta percha and next add 2 kilos of finely powdered Syrian asphalt. After standing for several days, the mass becomes uniform. If it should be too thin, boil it down, so that when cold it is of the consistency of honey.

This cement keeps for an unlimited period. When using it, the leather should be first unoiled with benzine at the place where it is to be coated with the cement.—Seifensieder Zeitung.

A New Sympathetic Ink.—The Pharmaceutische Post gives the following directions for its preparation: Phenolphthalein is known to give with alkalies one of the handsomest color reactions by assuming an intense red shade. The writing done with a weak phenolphthalein solution prepared with diluted alcohol is hardly visible on the paper, but makes its appearance as soon as cotton moistened with soda solution or any alkaline solution is passed over the paper. No care is necessary, since the writing is not blurred, because the alkaline solution is absorbed by the paper and does not remain on the surface. For important documents, however, such as drafts, etc., it is not suitable, as it is effaced in time by the action of acid vapors, and even by the carbonic acid in the air.

Coating Aluminium with Silver, Gold, Copper, and Nickel.—The aluminium articles are first cleaned with diluted soda or potash lye or with diluted hydrochloric acid (1 : 10) and are then washed off well with water. Lanseigne and Leblanc obtained good results with the following baths:

Silver.—Silver nitrate, 20 grammes; potassium cyanide, 40 grammes; sodium phosphate, 40 grammes; water, distilled, 1,000 grammes.

Gold.—Gold chloride, 40 grammes; potassium cyanide, 40 grammes; sodium phosphate, 40 grammes; water, distilled, 2,000 grammes.

Copper.—Copper cyanide, 300 grammes; potassium cyanide, 450 grammes; sodium phosphate, 450 grammes; water, distilled, 5,000 grammes.

Nickel.—Nickel chloride, 70 grammes; sodium phosphate, 70 grammes; water, distilled, 1,000 grammes.

The baths are heated to 60°-70° C. and maintained at this temperature. Besides, it is necessary that the anodes consist of the same metal as is contained dissolved in the bath.—Journal der Goldschmiede Kunst.

Winter Beverages.—The Deutsche Destillateur Zeitung gives the following receipts for winter beverages:

Campchello.—Thoroughly beat the yolks of 12 fresh eggs with 1 kilo finely powdered, refined sugar, the juice of 3 lemons and 2 oranges, and 3 bottles of Grâves or other white wine, over the fire, until rising. Remove, and slowly beat 1 bottle of Jamaica rum with it.

Egg Wine.—Vigorously beat 4 whole eggs and yolks of 4 eggs with 250 grammes of fine sugar, next add 2 liters of white wine and beat over a moderate fire until rising.

Christophelet.—Coarsely crush 5 grammes each of cinnamon, cloves, cardamoms, and cubebs, pour 1½ liters of claret over and heat to a boil. Pour through a cloth and add ½ kilo of sugar. After cooling, add 1 liter of good Cognac.

Whist.—Cause 15 grammes of Souchon tea to draw five minutes in ½ liter of boiling water, pour through a cloth upon ½ kilo of refined sugar and add the juice of 6 lemons and 2 bottles of Médoc (claret). Heat to ebullition.

Bavaroise au Cognac.—Beat up the yolks of 8 eggs in 1 liter of good milk over the fire, until boiling, then quickly adding 150 grammes of sugar and ½ liter of fine Cognac.

Bavaroise au Café.—Heat ½ liter of strong coffee and ½ liter of milk, 150 grammes of sugar, and the yolks of 8 eggs, until boiling, then add ⅛ liter of Jamaica rum.

According to The Furniture Worker, a pneumatic rocking chair is one of the recently invented novelties. The cushion, which resembles a section of a bicycle tire with conical ends, rests in sockets provided in the wooden framework. One of these is placed under each rocker, and upon these cushions or tires the weight of the person in the chair rests. The cushions may be inflated to any degree of hardness agreeable to the occupant of the chair by the familiar bicycle pump. They are noiseless and have a smooth, even motion and give no appreciable wear or tear to the carpets or rugs, and they do not scratch a hard-wood floor.

SELECTED FORMULÆ.

Tableting Glue.—Glue, 1 pound; glycerin, 4 ounces; glucose sirup, 2 tablespoonfuls; tannin, ⅒ ounce. Use warm, and give an hour to dry and set on the pads. Can be colored with any aniline dye.—Inland Printer.

Treatment of Carbolic Acid Burns.—Thoroughly wash hands with alcohol, when (Univ. Med. Mag.) the burning and tingling will almost immediately cease. Unless employed immediately, however, the alcohol has no effect. When the time elapsed since the burning is too great for alcohol to be of value, brush burns with a saturated solution of picric acid in water.

Furniture Cream.—

Soap, Castile	2 parts.
Potassium carbonate	1 "
Yellow wax	16 "
Oil of turpentine	16 "
Water	60 "

Dissolve the potassium carbonate in the water by the aid of heat, and strain into a large jar; melt the yellow wax, take the vessel from the fire, and add the oil of turpentine. Now mix the two solutions, and stir well. Put up in six-ounce, round-shouldered, wide-mouthed bottles.

FURNITURE PASTE.

Paraffin wax	7 ounces.
Petroleum jelly	2 "
Solution of potassa	5 drachms.
Yellow wax	3 ounces.
Alkanet root	1 "
Turpentine	12 "

Place the first four ingredients in a vessel and melt with gentle heat; then add the others, digest an hour, and strain.

FURNITURE POLISH.

Shellac, best quality orange	1,000 parts.
Rosin	65 "
Venice turpentine	200 "
Alcohol	2,600 "

Mix and put in a warm place, agitating frequently until the resins are dissolved. Let stand for four weeks, or until completely limpid, then decant.—Bulletin of Pharmacy.

Theatrical Grease Paints.—The following formulas are selected from the Standard Formulary, where still others may be found:

WHITE GREASE PAINT.

Prepared chalk	4 av. oz.
Zinc oxide	4 "
Bismuth subnitrate	4 "
Asbestos powder	4 "
Sweet almond oil, about	2½ fl. oz.
Camphor	40 gr.
Oil peppermint	3 fl. dr.
Esbouquet extract	3 "

Sufficient almond oil should be used to form a mass of proper consistence.

RED GREASE PAINT.

Cacao butter	4 av. oz.
White wax	4 "
Olive oil	2 fl. oz.
Oil rose	8 drops.
Oil bergamot	3 "
Oil neroli	2 "
Tincture musk	2 "
Carmine	90 gr.
Ammonia water	3 fl. dr.

Melt the cacao butter and wax, add olive oil, stir in the carmine first dissolved in the ammonia, add the volatile oils and tincture, and form into sticks.

BLACK GREASE PAINT.

Soot	2 av. oz.
Sweet almond oil	2 fl. oz.
Cacao butter	6 av. oz.
Perfume	sufficient.

The soot should be derived from burning camphor and repeatedly washed with alcohol. The soot should be triturated to a smooth mixture with the oil; then add to the melted cacao butter; add the perfume, and form into sticks.

Brown or other colors may be obtained by adding appropriate pigments, such as finely levigated burned umber, sienna, ocher, jeweler's rouge, etc., to the foregoing base instead of lampblack.

Rat Poisons.—

ARSENICAL POISONS.

We give herewith some preparations containing arsenic or arsenious acid in various forms, usually, however, as arsenic and Schweinfurth green, rubbed up with flour or meal, or with fats, meats, fish, or cheese. Of its promptness and efficacy there is no doubt, but its high potency, its lasting toxicity, its tendency to the emission of hydrogen arsenite into the surrounding atmosphere, and especially when prepared into moist, clyster-like masses, with flour, etc., make it a most dangerous agent to use, particularly around the dwelling, and in places occupied by human beings. The following are some of the formulæ given by Hager for preparing giobules, or pills, of arsenic:

1. Arsenic, white, powdered. . . . . 20 grm.
   Soot from the kitchen . . . . . 1 "
   Lard, sufficient.
   Wheat flour, sufficient.
   Oil of anise . . . . . 20 cgrm.

   Make into 400 globules.

2. Beef suet . . . . . 500 grm.
   Rye flour . . . . . 500 "
   Arsenic, white, powdered . . . . . 50 "
   Ultramarine . . . . . 10 "
   Oil of anise . . . . . 1 "

   Melt the suet, and add to the flour, mix in the other ingredients, and work up while hot, beating the mass with a roller. Make 1,000 globules.

3. Arsenic, white, powdered . . . . . 10 grm.
   Fresh bread crumb . . . . . 200 "
   Molasses, sufficient.

   Mix, and make into 200 globules. Arsenic may be used in the same manner as strychnine.—Extracts from a paper in the Apotheker Zeitung by A. Roderfeld. Translated for The National Druggist.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Metric Classification of German Iron Manufacturers.—Under date of December 12, 1899, Consul Hill, of Amsterdam, transmits copy of a report made by Mr. W. C. Robinson, British consul at that city, to the Wolverhampton Chamber of Commerce on the commercial value of the metric system, and the loss, present and prospective, of British trade on account of the non-adoption of that system. The British consul, to give pointed illustration to his report, gives as the text of his paper the classification of German iron manufactures.

Consul Hill says that the report and advice of the British consul, a man who has been connected with large business enterprises in Germany and the Netherlands, are worthy of serious consideration by the commercial bodies of the United States.

THE BRITISH CONSUL'S REPORT.

The iron and steel manufacturers' unions of Germany have adopted a uniform system of dimensions for articles of universal consumption at home and abroad.

Take, for instance, the enormous production of angle iron of all descriptions. These are rolled by all manufacturers in the Zollverein, in identical dimensions, called "Deutsche normal profile" (German normal profiles), and each section is designated by a number in the following manner: "1 N. P. 30," which gives the complete specification of a section. With these specifications and price lists, printed tables are furnished which give all necessary technical information as regards the weight of each section, the load which it can carry, the sizes of the connecting rivets, etc.

Dealers both at home and abroad keep the sections most in demand in stock, and the universality, identity, and completeness of the normal sections are naturally of the greatest value to buyers and builders.

A further instance may be given in the manufacture of flanged boiler ends or fronts for Cornish or Lancashire boilers, with or without furnace holes. These boiler fronts are made in sizes up to 3 meters (9·843 feet) in diameter by all the different iron and steel works in the Zollverein in the same standard sizes, rising by 10 centimeters (3·75 inches) for each size required. As all the boilers are now constructed in standard sizes, there is a great convenience for buyers in every part of the country, who are thus enabled to procure at once the exact size they require.

As a further instance, iron and steel tubes and all fittings connected with them, such as valves, cocks, T pieces, are made, so far as flange diameter and working lengths are concerned, in normal, standard sizes, in order that every part of one work may be procured at once to fit every corresponding part of another construction. These normal standards are all fixed by the free co-operation of the combined German engineers' unions and are unanimously adopted by the various manufacturers all over Germany.

A present a committee of the engineers' unions is occupied in endeavoring to fix a metric thread for bolts and screws, nuts, bolt heads, etc., as the present universal normal standard (the Whitworth) is so differently constructed by different works that the parts are not as interchangeable as should be the case.

These classifications are naturally making more and more progress in Germany, not in the iron trade alone, but in other manufactures. I am quite aware that the same system exists to an extent in Great Britain, and also that some large works there have adopted the metric system. But I wish to lay stress upon what appears to me to be the case, that in Germany there is a much more systematic procedure in this respect, and, above all, that Germany and the Continent generally will have a constantly increasing advantage over British manufacturers in the future in foreign countries, unless the metric system be fully and entirely adopted by Great Britain. I may instance as an undoubted fact that the preference which Germany has obtained here over Great Britain as regards railway bridges and other railway material is mainly owing to the existence of this metric classification. And as regards pipes and tubes for waterworks, it is absolutely certain that the Dutch market is completely lost to Great Britain, so far as any new constructions are concerned, from the same cause. Existing waterworks which had adopted English iron in the commencement may still send orders to England. Perhaps, no stronger instance in favor of the metric system of classification can be given than the fact that a Belgian firm of repute, which lately obtained a large contract for water piping in this country, was obliged to guarantee that the German system of normal classification should be adopted in the manufacture of the pipes and tubing.

It appears to me evident that where competition with countries enjoying the advantage of the metric system becomes, as it is daily becoming, more and more severe, those countries which already hold that advantage must eventually obtain the priority, unless the competitor adopts the same principle. If I am correctly informed, a combination of Belgian iron manufacturers has already started works in China, where probably the Belgian systems, and therefore the metric system, will be introduced.

Clock Trust in Japan.—Consul-General Gowey sends from Yokohama, December 28, 1899, a clipping from the Yokohama, Japan, Mail, which, he says, may be of use in calling the attention of American manufacturers of clocks to the condition of the trade in Japan and to the competition to be expected in the markets of Siberia, China and India.

Japanese-made clocks of the value of $77,615, he adds, were exported during the year 1898. The clipping reads:

The manufacture of clocks in Japan has now entered upon a stage of prosperity, remarks the Tokyo Asahi. The output has not only proved sufficient to supply the demand in the interior, but a large number are exported to China, India, Siberia, and the various islands in the South Pacific. As a natural consequence of this, however, competition has arisen between the manufacturers to such an extent as to bring about serious losses. To obviate this difficulty, the leading clock companies in Osaka—fifteen in all—recently formed a union and determined to carry out an arrangement from the beginning of next year, according to which clocks are divided into several classes, with fixed minimum value. Spurious manufacture is prohibited, and offenders are subjected to a penalty of not less than 1,000 yen ($498). The offices of the union are to be established at Nagoya, while the expenses of its maintenance are to be met by a contribution of 1 sen (½ cent) for each clock manufactured.

Reform in the German Consular Service.—The "seniors" of the Merchants' Association of Berlin have addressed a memorial to the Prussian Secretary of Commerce, and at the same time to the Chancellor of the German Empire, which appears to be in response to an inquiry from the Secretary of Commerce, and states what reforms in the German consular service are deemed necessary. The following is a synopsis of the somewhat lengthy document: The main duty of the consul should be to make careful and detailed reports concerning economic occurrences in his consular district. These reports should give not only the figures of the exports and imports, but should also deal with the development of the commerce and the home industries of the country. The consul should be able to point out these conditions upon his own initiative, as well as in response to inquires from home. He should be well informed about commercial matters at home, as well as in touch with the business world of his district. Means should be at his disposal for travel, and he should be compensated for services rendered. Knowledge of the language of the country, as well as of the leading languages of the world, should be of prime consideration. The promotion system of Great Britain should be followed, whereby consuls are transferred between countries where the same languages and similar economic conditions prevail, so that transfers of a consul from China to Russia and thence to Spanish America, for example, should be avoided. Reports concerning the commerce of the foreign country should give comparisons with previous years and be published at home in such a manner as to reach all interested.

The letter says that these requirements are more or less realized in foreign countries. The consuls of the United States of America especially have rendered very useful services to the commerce and industries of their home country and have furnished proof that the establishment of commercial consulates bears rich fruit, in spite of the fact that a consul can hardly acquire such special knowledge of trade conditions in the several branches as an agent of some business house.

The letter endeavors mainly to show the great desirability of substituting the large number of German "Wahlkonsuln"—i. e., German merchants resident in some foreign country who act as consuls—by regularly paid consuls, who will give their whole time to their consular duties, and states that a reform is expected mainly from an increased and improved service in the regular consulates, recommending the appointment of commercial attachés to the important consulates, as has already been done at Chicago, Buenos Ayres, and Constantinople.

It is recommended that the qualifications for appointment as consuls should be of a more practical nature and not so much the mere knowledge of law. It is stated that to carry out the reforms suggested, an increased appropriation for the consular service would be necessary, which may appear large compared with the present expenditure, but which would prove insignificant if the importance of the work accomplished is considered—that is, the increase of German commerce, especially the exports of German manufactures. The letter also calls attention to the great usefulness of the Philadelphia Commercial Museum.—Richard Guenther, Consul-General at Frankfort.

Windmills in Syria.—Under date of Beirut, December 7, 1899, Consul Ravndal writes to an Indiana firm:

What is needed here is a windmill for irrigation purposes—an outfit which will furnish a supply of water from wells averaging 50 to 60 feet in depth, sufficient to irrigate gardens and small farms 10 to 15 acres in extent. Water is obtained from natural springs and open wells. From the latter the water is drawn by horse, ox, or donkey power, in buckets attached to ropes revolving over a large drum directly above the well. One side descends while the other rises, carrying the small buckets with them; those descending are empty, while the ascending ones are full, and as they pass over the top, they discharge into a trough, which conveys the water to the cistern or into irrigating ditches. The buckets are fastened to the hawsers about two feet apart, and the system is fairly effective, being usually applied to wells 12 to 20 feet deep, though it may also be utilized to a depth of 150 feet.

Winds prevail in most parts of the country during all seasons of the year, those from the southwest and north being the strongest and most persistent, at least along the littoral. August and September are the calmest months and also the driest, but even then we have afternoon and night breezes presumably sufficiently competent to operate our easy-going mills.

I know of only two modern windmills in my consular district, both of American manufacture. One is a Wolverine (Chicago) imported by a native residing near Damascus. Mr. Meshaka, our consular agent there, writes me that "it cannot be fixed for work before next spring, when it will be possible to tell the effect which it will produce upon the people." The other is a Halladay (Batavia, Ill.), erected on the grounds of the insane asylum, a missionary institution at the foot of Mount Lebanon, four or five miles out of Beirut. It is used for elevating water from a spring 40 feet into a reservoir, from which the buildings and the garden are supplied. I have several times inspected this windmill, and have taken prominent natives there in order that they might familiarize themselves with wind engines in general. It works beautifully, and a neighbor, owner of a silk factory, ordered a similar one a few days ago.

No American windmill company has an agent here, and windmills for irrigation purposes are entirely unknown. At Sidon and Haifa, there are two or three windmills, some ten years old, which pump water for domestic use. They do not seem to have aroused any particular enthusiasm, as people here are mostly concerned about facilities for irrigating their lands. In my consular district, there are altogether perhaps half a dozen windmills of European origin, but they are generally admitted to be failures. They are clumsy and heavy and difficult to keep in order. I was told a couple of days ago that near Aleppo, there have recently been introduced between twenty and thirty Aermotor windmills (Chicago). Aleppo is in the Alexandretta consular district.

Syria and Palestine, on account of the defective means employed for utilizing the abundant subterranean water supply, are justly called semiarid regions. The introduction of boring and pumping machinery will no doubt prove a great boon to this country. The American missionaries at Sidon own a very expensive drilling machine, and have been at work for two years trying to reach the artesian basin. If they do not succeed at Sidon, they intend to move the machine into the Bekaa plains, between the Lebanon and the Anti-Lebanon, where artesian wells can no doubt be sunk successfully. Other semiarid districts, where agriculture even under present unfavorable conditions is carried on extensively, are the Hauran and Hamath plains. At Sidon, ordinary water was struck, while the above-mentioned experiments were pursued, at a small depth, and there is talk of importing up-to-date windmills to use this supply in irrigating the orange groves.

I believe, also, that wind power could be advantageously employed here to run the very primitive flour mills, wine and olive presses, etc., of this country, now operated by water or horse power. The firm of Sabbag & Son expects to use our pumps and wind engines in its bitumen mines in Palestine, which must be constantly drained to prevent inundation. This firm does an export business to the United States amounting to a round million dollars per annum, chiefly in wool, licorice, and bitumen. This is their first departure in the field of imports.

There are in this country, to my knowledge, two American engineers—one at Sidon and one at Alexandretta—the latter in charge of Mr. Sabbag's licorice-root presses.

Descriptive matter should be mainly in French and English, and too much cannot be sent. Advertising is a novelty here and attracts attention.

As to the customs duty, I have endeavored to persuade the collector to admit windmills without charge under the clause allowing agricultural implements free entrance. I have not as yet received a final answer. The ordinary duty on imports is 8 per cent. ad valorem.

Export of Pulp Wood from Ontario Prohibited.—Commercial Agent Shotts, of Sault Ste. Marie, on January 16, 1900, says:

The government of Ontario has decided that no pulp wood cut from Crown lands after May 1, 1900, shall be exported from the province. This step has been urged for some time, its advocates claiming that it would greatly stimulate the local manufacture of pulp and paper. It is stated that the province of Quebec will also place on all pulp wood taken from Crown lands an export duty sufficiently high to practically prohibit its shipment. This will allow the cutting of this winter to be exported during the coming summer. New mills are being built at various places, advantageous situations are being sought, old mills are increasing their capacity, and the prospect is that the paper and pulp industry of Canada will assume large proportions in the near future. There were 37,073 cords of pulp wood exported from this district during the year 1898, 61,398 cords in 1899, and information received indicates a larger export for 1900.

German Textile Exports.—Vice-Consul-General Hanauer, of Frankfort, under date of December 18, 1899, sends a clipping from the Confectionair, a leading organ of the German textile and clothing trade, as follows:

There seems little probability of a change in the present tariff rates of the United States. This condition is favorable to the Chemnitz textile manufacturers, as they have adapted themselves to conditions by marking their chief lines of goods at prices in accordance with the present tariff. Any change would disarrange the marking in these lines. Only on woolen and half woolen articles would it be to the interest of our manufacturers to have the rates reduced; but this is a futile hope, and therefore the export of these to the United States receives less and less consideration, especially as goods of this class are now produced in excellent quality and style by the domestic manufacturers of the United States. Only the very finest and lightest woolen textiles can now be exported by us to that country. Owing to the great advance in the price of yarn, these woolen textiles have increased in price so much that buyers protest.

Advance in Shoe Prices in Germany.—Under date of December 9, 1899, Consul Worman, of Munich, says that the Shoe and Upper Manufacturers' Union (Verband der deutschen Schuh- und Schäfte Fabrikanten) has, according to its official organ, the Schuh markt (Shoe Market), of recent date, served notice by circulars to the trade that, in consequence of the marked rise in price of materials, such as leather, cloths (cotton and woolen), silks, nails, etc., a very considerable advance in prices must be made. It sets forth that prices have already been considerably advanced in the United States, Austria, France and England.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

GEARING FOR THE REDUCTION OF ANGULAR VELOCITY.

GREAT difficulties are now met with in industrial applications when it becomes a question of transmitting motion from an engine to a machine. In order to actuate any machine tool or a dynamo by a steam, gas or gasoline motor, it is indispensable to have recourse to an intermediate transmission. The machine tool or the dynamo revolves at a high angular velocity, while the motor runs at a feeble one.

In a few particular cases it has been possible to reduce the angular velocity of dynamos to a certain degree, and, on the contrary, to increase that of steam engines, and in this way to obtain direct transmissions, that is to say, to realize the ideal of transmitting motive power. In the electric industry, we have generators that are established according to this principle and that run at angular velocities of from 400 to 500 revolutions per minute, and give entire satisfaction. But it is not always possible to obtain such results. In order that they shall operate properly, it is sometimes necessary that the apparatus shall revolve at low angular velocities, while the motor, by its nature, is required to run at a very high angular velocity. This is the case, for example, with continuous current electric motors, and especially with simple and polyphased alternating current ones. The number of poles is necessarily limited, and the angular velocity forcedly reaches a high figure. These observations have a special weight just at present, when the transmission of electric energy in manufactories is beginning to be effected through electric motors that actuate the machine tools directly. It must not be forgotten either that electric motors are destined to play an important part in the construction of electric automobiles.

This important and difficult problem of the transmission of the energy of the motor to the apparatus that is to utilize it has not, in our day, received any other solutions than those that consist in the use of intermediate transmissions in the shape of belts and pulleys. So it is with great interest that we have at various times examined and studied the Humpage epicycloidal angular velocity reducer with progressive gearing, which we illustrate herewith.

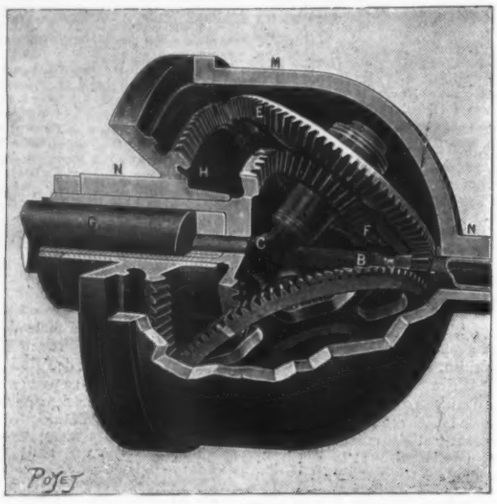


FIG. 1.—THE HUMPAGE GEARING FOR REDUCING ANGULAR VELOCITY.

Fig. 2 gives a general view of the installation that we saw in operation last June at the International Exposition of Automobiles. An electric motor placed at the right was supplied by the energy furnished by a distributing company of Paris. Running at an angular velocity of about 2,000 revolutions per minute, it actuated, through a reducing gearing (shown in the center of the figure), a pulley over which passed a belt and which revolved from 180 to 200 times per minute.

The gearing for reducing the angular velocity is represented in internal section in Fig. 1. Upon the shaft of the motor revolving at a high angular velocity is keyed a conical pinion, *B*. At *C* there is a sleeve that revolves loosely upon the shaft and carries two arms arranged at an angle of 180° with respect to each other. Each of these arms supports a toothed wheel, *F*, and, above the latter, another and larger toothed wheel, *E*. These two wheels are fixed and revolve in unison. The toothed wheel meshes with the wheel of the conical gearing, *B*.

Upon the shaft, *G*, to the left, that revolves at a low angular velocity, is keyed a wheel provided with internal teeth, and which gears with the wheel, *F*. Above the conical gearing there is another mounted loosely upon the two shafts. This gearing, which is connected with the wheel, *H*, supports, on the one hand, to the left, the pulley, *N*, and at *M* the case that contains all the actuating apparatus, and, on the other hand, carries to the right the pulley, *N*. The reducing gearing consists, upon the whole, of three conical gearings—one mounted upon the shaft of high angular velocity, the second mounted loosely upon the two shafts, and the third mounted upon the shaft of low angular velocity. The connection between these three gearings is made by means of two planet wheels with double toothing mounted upon a sleeve that revolves around the common axis of the two shafts.

The gearing operates in the following manner. The brake is first applied to one of the pulleys, *N*, in order to render the gearing, *H*, immovable. The wheel, *B*, actuated by the shaft of high angular velocity, actuates in turn, through the toothed wheels, *E* and *F*, the planet wheels and, consequently, the shaft of low angular velocity.

The ratios of reduction are easily calculated by a formula which we shall not dwell upon here. Let it suffice to say that for a total number of 148 teeth, it is possible, without changing the dimensions of the gearings, and by varying the number of the teeth of the various wheels, within narrow limits, to obtain ratios of reduction of 7·95, 10·65, and 27·55.

The Humpage reducer of angular velocity seems to us to combine a large number of advantages that ought to attract the attention of the industrial world. In the first place, it is of simple and strong construction and occupies but little space, and, in the second, it readily lends itself to the solution of various problems of transmission through simple changes in the number of the teeth of the various wheels. Through the arrangement of its elements, the actions are symmetrical, and no reactions upon the pillow blocks are to be apprehended. Finally, its parts are incased and protected from dust and are capable of working in oil.

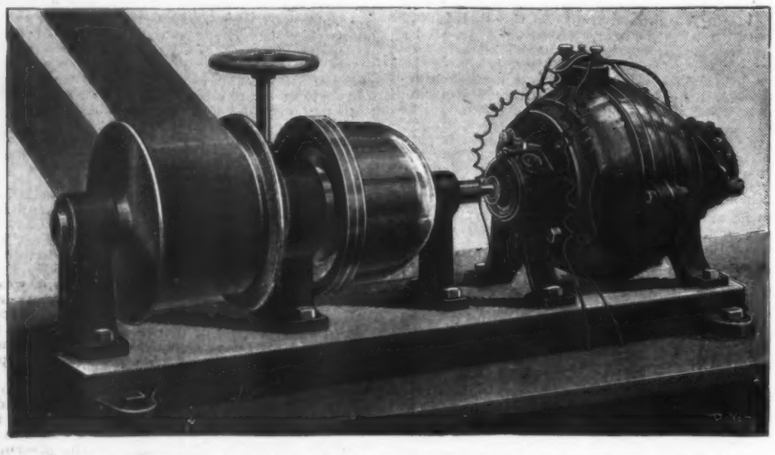


FIG. 2.—A SHAFT ACTUATED BY AN ELECTRIC MOTOR THROUGH THE INTERMEDIUM OF A HUMPAGE GEARING.

From a practical point of view, the gearing is progressive, a very important matter for the starting of a machine, and all that is necessary is to tighten or loosen at will the driving wheel by means of a handwheel. The gearings produce no disagreeable noise, since the wheels all revolve in a bath of oil with friction of bronze upon steel.

The rendering of this apparatus is satisfactory and permits of its use in the industries. There is still another point that must not be neglected. The mean rendering reaches about 90 per cent. Some interesting experiments have been made in this regard in England. It was a question of transmitting a mean 3 horse power and of reducing the angular velocity from 820 to 100 revolutions per minute. Two series of experiments were made. In the first of these, the maximum rendering was 97·03 per cent. and the minimum 86·76, say an average of 90·56 per cent. In the second series, the maximum and minimum renderings were respectively 92·39 and 81·39, say an average of 88·94 per cent.

Upon the whole, the first results furnished by the Humpage gearing appear to us to be extremely satisfactory. It is to be hoped that the experiments will be further pursued, so as to assure the industries a simple and practical transmission of energy from motors to the apparatus that utilize it.

For the above particulars and the illustrations we are indebted to La Nature.

AN AMERICAN PACIFIC CABLE.*

By GEORGE OWEN SQUIER.

IT is interesting to note that the idea of a trans-Pacific submarine cable was first discussed and considered by the late Cyrus W. Field, nearly thirty years ago. The scheme of Mr. Field and his associates involved a route from California via Alaska and the Aleutian Islands to Japan. Since that date, the subject in some form has been almost constantly before this country and Great Britain. This question has been discussed in the fifty-second, fifty-fourth, and fifty-fifth Congresses, in each of which effort was made looking toward laying a cable at least as far as the Hawaiian Islands.

In a special message to Congress, dated February 10, 1899, the President says:

"As a consequence of the ratification of the treaty of peace between the United States and Spain, and its expected ratification by the Spanish Government, the United States will come into possession of the Philippine Islands, on the farther shore of the Pacific. The Hawaiian Islands and Guam becoming United States territory, and forming convenient stopping places on the way across the sea, the necessity for speedy cable communication between the United States and all these Pacific islands has become imperative. Such communication should be established in such a way as to be wholly under the control of the United States, whether in time of peace or of war. At present the Philippines can be reached only by cables which pass through many foreign countries, and the Hawaiian Islands and Guam can only be communicated with by steamers, involving delays in each instance of at least a week. The present condition should not be allowed to continue for a moment longer than is absolutely necessary."

The idea of a British Pacific cable, connecting the Dominion of Canada with the Australasian colonies, almost from the first has been discussed from a national standpoint. Her Majesty's government and the Colonial governments most concerned have been urged from time to time to consider the matter in its strategic and commercial aspects. Two colonial conferences, in 1887 and 1894, were largely occupied with this subject, as evidenced by the exhaustive blue books which record their proceedings. The Dominion government took the matter up in 1893–4, and invited the most reputable firms in the world to submit estimates for construction and laying.

In 1896, Mr. Chamberlain, Secretary of State for the Colonies, appointed a Pacific Cable Commission, which included among its members the Under-Secretary of State for the Colonies, the High Commissioner of Canada and the Agents-General for New South Wales and Victoria. This committee went into the whole subject of the practicability, cost, probable revenue, and management of the proposed enterprise and elicited a fund of technical, commercial, and professional information upon cable manufacture and cable laying in general, and upon this important project in particular, which is invaluable, and which probably could not have been obtained in any other manner. At this moment a Pacific cable touching only soil belonging to Great Britain is assured, both Canada and Australasia recently having been reported as joining with England in pledging themselves to the enterprise as a government undertaking.

The proposed route with surface distances involved is shown on the accompanying map, and is from Vancouver to Fanning Island, thence to the Fiji Islands, thence to Norfolk Island, and from there bifurcating to New Zealand and Queensland.

Since a Pacific cable will at last complete the telegraphic circuit of the globe, it will give the peculiar advantage of placing each point thereon in cable connection with every other point by two distinct routes either east or west.

The cardinal idea in the British system has been that all state cables shall touch only British soil, and this principle has placed British cable traffic in the Pacific forever at a disadvantage over the American cable, for the reason that the only available route involves a single span of cable from Vancouver to Fanning Island, over 3,500 miles in length; whereas, by the annexation of the Hawaiian Islands, the United States, while following a similar principle, will have no span longer than the present Atlantic cables, or about 2,500 miles in length.

Since the speed of cabling decreases in general with the square of the length of the cable, and the speed of the whole system is limited by the speed of the slowest span, that system requiring the longest single span is ultimately at a disadvantage, provided the systems are in direct competition. In the projected Pacific cable enterprises, however, although, as will be pointed out

* A paper presented at the 138th Meeting of the American Institute of Electrical Engineers, New York, December 27, 1899.

later, they will operate in close relations with each other, yet each has a sufficient prospective traffic to guarantee the enterprise as a sound financial success from the beginning.

AMERICAN CABLE ROUTES.

In the consideration which, from time to time, has been given the project of spanning the Pacific Ocean by a submarine cable, the northern route, via Alaska, the Aleutian Islands, Siberia, and Japan, has been frequently proposed.

In recent years the British government, in its proposed line from Canada to Australasia, first projected this northern route owing to the absence at that time of information respecting the Southern Pacific Ocean, and the impression which prevailed that physical difficulties existed which offered insuperable obstacles to the laying of a cable on a direct route between Canada and Australasia. In consequence of this impression, it was designed to lay the cable from Vancouver to Japan, touching at islands in the Aleutian and Kurile groups as mid-ocean stations. From Japan the connection with Australasia would have been obtained via Singapore and the Eastern Extension Company's lines of telegraph. Through the intervention of the government, negotiations were opened with the view of securing one of the Kurile Islands. Japan was asked to transfer to the British crown one of these islands, in order that the telegraph station should be under British protection, and an agent was sent to Washington, who, after some difficulty, obtained conditional landing privileges on one of the Aleutian Islands.

Recently there has been a revival of interest in this route, especially now that the growing commercial interests of Alaska are becoming important. The plan proposes starting from Cape Flattery, thence to Sitka, distance (approximate) 803 miles; thence to Kadiak Island, 682 miles; thence to Dutch Harbor, 770 miles; thence to Attu, 810 miles; thence to Japan-Russian border, 858 miles; thence to the Japanese land lines, 810 miles; from the Siberian border to the Siberian lines, 617 miles; and from Formosa to Luzon, 200 miles; in all 5,550 nautical miles, exclusive of the Japanese system.

It will be noticed that this series of cables aggregating 5,550 miles makes no provision for American communication with the Philippines, except over the Japanese land lines from the north point of Japan to the south point of Formosa, a distance through a foreign territory of about 1,200 miles. Owing to the uncertainty of the Japanese land lines, which are frequently interrupted during the typhoon season, particularly in Formosa, it would be necessary, in order to insure communication, to extend the Japanese cable system. Again, the Great Northern Telegraph Company, a Danish corporation, has exclusive rights, not only on the Siberian coast, but also between Japan and the Asiatic coast.

Apart from establishing telegraphic communication free from foreign control between the United States, the Hawaiian Islands, the Philippine Islands, and the island of Guam, the mission of an American Pacific cable should be to bring about a general reduction of cable rates.

On the Alaskan route a large number of intermediate stations must be established and maintained; and there must be a division of receipts with Japan. A message via Honolulu, an intermediate island station and Guam, would reach Luzon by four cable transmissions. The Alaskan route as proposed would necessitate about fifteen separate stations, of which nearly one-half would be under Japanese control.

Undoubtedly an Alaskan cable will soon be required, and apparently also the extension of such a cable system as a means of attaining a through line to the Philippine Islands is an attractive plan. This plan, however, leaves the United States in practically the same unsatisfactory position she is in at present in respect to communication with her Pacific possessions, and until definite and perpetual concessions are forthcoming, can furnish even no guaranty of substantial reduction from the present high rates.

It is believed that no one studying the true present and future interests of the United States can come to any other conclusion relative to an American Pacific cable than the one so admirably expressed by the President in his special message to Congress, viz., that this cable shall be "wholly under control of the United States."

This cardinal idea, the principle also adopted by Great Britain, after years of exhaustive consideration, at once excludes the northern route for the present, and limits the route to American territory.

PRACTICABILITY.

There is no longer any doubt as to the practicability of the Pacific cable project from a technical and engineering point of view. A preliminary survey between the coast of California and the Hawaiian Islands was completed by the Navy Department in 1892,* showing the entire practicability of this part of the route. Between California and the Hawaiian Islands several approximately parallel routes are practicable, but the one which seems to be favored by the survey of 1892, as shown in the report of the Hydrographic Office of the Bureau of Navigation, is a rhumb-line between Monterey Bay and Honolulu on Oahu Island. The U. S. S. "Nero," under command of Commander Charles Belknap, U. S. N., has been engaged since April last in a survey of the bed of the Pacific along the proposed route of the cable from the Hawaiian Islands westward to the Philippine Islands and to Japan. A preliminary report of this survey recently received adds greatly to the knowledge of this part of the Pacific and to the data necessary before determining the exact route of the cable. This survey develops two unusual physical features along the route via Midway Island; one of these is a submarine mountain, situated a short distance westward of the Midway Islands and rising from the floor of the ocean, having a depth of 2,200 fathoms to within 82 fathoms of the surface. The second feature is one of the deepest submarine abysses yet found in the world, situated about 500 miles eastward of Guam and more than 4,900 fathoms in depth. These and other obstacles which may be found, however, can be avoided in laying the cable by making suitable detours around them, as is ordinarily done.

* See Senate Document 153.

A MID-OCEAN ISLAND CABLE STATION.

The great decrease in speed and increase of cost consequent upon increase of length of a single span of the cable, requires a landing station, if possible, between the Hawaiian Islands and Guam. The longest cable yet laid and in operation is the French cable from Brest, France, to Cape Cod, Mass., which is about 3,250 nautical miles in length, and there is no question that a cable directly connecting Honolulu and Guam could be successfully laid, if no practicable landing place between these two points could be obtained. This single span, however, about 3,650 nautical miles, including "slack," would for all time so reduce the through speed of the cable, and so increase the original cost, as to warrant unusual expense, if necessary, in preparing and maintaining an intermediate station. In this connection the large amount of technical evidence given before the British Pacific Cable Committee relative to the Vancouver-Fanning Island span, which is practically the same extreme length of 3,600 nautical miles, and of the utilization of Fanning Island as a station, are valuable as showing entire practicability. Although both Wake and Midway Islands, which have been proposed as stations, are low atolls, rising but a few feet above high water and with little to sustain human life, yet either of these places is equal, if not superior, to Fanning Island. Further careful surveys will be necessary before the exact route west from the Hawaiian Islands to Guam can be finally determined. Fortunately for this enterprise, the annexation of the Hawaiian group brought under the sovereignty of the United States eleven or twelve small, rocky or sandy islands extending to the northwestward about 1,800 miles from Honolulu. These must be surveyed and considered from the cable standpoint before a final selection of route can be made.

MAP SHOWING ROUTES OF AMERICAN AND BRITISH PACIFIC CABLES.

The distances in nautical miles along two provisional routes, including ten per cent. for "slack" in laying, are as follows:

	Miles.
San Francisco to Honolulu	2,286
Honolulu to Midway Island	1,254
Midway Island to Guam	2,523
Guam to Dingala Bay, P. I.	1,496
Total via Midway Island	7,559

	Miles.
San Francisco to Honolulu	2,286
Honolulu to Wake Island	2,203
Wake Island to Guam	1,435
Guam to Dingala Bay, P. I.	1,493
Total via Wake Island	7,422

In Appendix I. are shown the great circle and rhumb line distances involved and the geographical positions used.

COST, MAINTENANCE, AND OPERATION.

The cost of laying cable depends mainly upon the materials used in its construction, and therefore fluctuates with prices current. The outer coverings are much the same in all specifications, according to the conditions of the case, but the copper conductor and the gutta percha insulation vary with the speed required over the cable. Since the length of the longest section of the proposed Pacific cable is approximately equal to each of several of the Atlantic cables, the type of the cable to be used for this section and the speed obtainable are subject to a close estimation.

Of the eleven cables spanning the North Atlantic, the Anglo-American Company's cable laid in 1894, and the Commercial Cable Company's cable No. 3, laid also in 1894, have the greatest speeds. The former contains 650 pounds of copper and 400 pounds of gutta percha, and the latter 500 pounds copper and 330 pounds gutta percha per nautical mile. Either of these types of cable would give good results, and no cables of less equivalent speed should be considered.

The following conservative estimate is made from the evidence obtainable relative to the establishment of this enterprise by the government on a sound financial basis:

MAINTENANCE AND REPAIR PER ANNUM.

Annual expenses of two cable repair ships	$200,000
Annual expense for new cable, assuming entire cable to be replaced in 40 years, or 200 miles per year	200,000
Working expenses	125,000
Reserve fund, and interest on capital	400,000
Total net earnings of cable required	$925,000

This provision for laying 200 miles of new cable per year should perpetually maintain the value of the cable as an asset, and the reserve fund further provides that the entire capital shall be replaced at the end of fifty years, or what is equivalent, that a sinking fund shall be established, which at the end of fifty years will be sufficient to lay an entire new cable in addition to the permanent maintenance of the original one, so that at the end of fifty years, two working cables will be provided for.

Taking average conditions for long cables ten years ago, the annual expenses for maintenance and repair, e. g., for new cable required, etc., and not including the fixed expenses such as the repair ships, was about $30 per nautical mile. The great advancement in cable manufacture since has reduced the average repair rate materially, but assuming this rate as it then averaged, the total charge to this item is practically the same as that given by the independent supposition above.

At present there is no first-class cable ship in the world flying the American flag and which would therefore be under the control of the United States in time of war. It should be the policy of the United States, whether the Pacific cable is laid by the government or by a subsidized company, to require that two complete cable repair ships, one, at least, also capable of laying long cables, equal to any yet constructed for these purposes, and flying the American flag, be stationed in the Pacific Ocean.

SPEED.

The "speed" of a cable is a somewhat loose expression and depends upon the voltage used, the particular apparatus employed in working the cable, as well as the design and construction of the cable itself, and the skill of the operators. Besides, there is a considerable margin between a speed which will do for press matter in ordinary plain language and the speed permitted for code and cipher messages.

"Speed" expressed in words per minute is misleading, since five-letter words are frequently taken as the basis, whereas in actual practice a telegraphic word averages about eight letters, the increase being due to code words, and the omission of many conjunctions and prepositions when messages are sent in clear. A better method of expressing speed in cabling is in standard letters of a certain number of signals each,

transmitted per minute, so that experienced operators can certainly and easily read them. The practical speed is the proportion of the maximum speed which remains after deductions are made for the words transmitted for which no revenue is received on account of service prefixes, etc., repetitions, errors, corrections, necessary interval between messages, administrative messages connected with traffic, etc. In determining the deductions from the maximum speed to obtain the practical speed in paying words per minute, there is little evidence at hand. In the perfected management of the Atlantic cables, where keen competition exists, this "dead" traffic has been reduced to 16 or 17 per cent. of the whole. For a Pacific cable an amount of "dead" traffic as great as 30 per cent. at first is estimated, and this could probably be reduced in successive years, as it has been in the Atlantic traffic. Assuming 30 per cent. for "dead" traffic, and an increase of 90 per cent. of speed for duplex working, it is estimated that the maximum capacity of the cable in total paying code words, of eight letters each, would be about 11,800,000 per annum. The cost of maintenance and operation, etc., as above being $925,000 per annum, the average cost of transmission per telegraphic word is about 0·8 cent.

In connection with speed of cabling, it may be said that the opinions of the best cable experts in the world as to the theoretical speed obtainable from a given cable over a given distance differ so widely as to inspire caution in making all estimates.

The present commercial rate from Washington to Manila is $2.38 per word, Government rate $2.255 per word, and the rate for "right-of-way" messages three times the normal rate.

It is seen that at the present commercial rate to Manila, after allowing for present land rates to San Francisco, the proposed cable is required to operate less than fifty minutes per day in order to earn the income of $925,000 per year. Allowing the present rate to be reduced one-half, the cable would have to work less than two hours daily. If the rate per code word, of an average of eight letters, is placed at fifty cents from San Francisco to Manila, then, upon the above supposition, the cable need operate daily less than four hours to meet expenses.

Assuming the cable to be interrupted as much as one-quarter of the entire time, the figures above still appear striking.

The desirability of the cable from an economic standpoint seems unquestioned. The Secretary of War says in his annual report:

"The cable tolls of the War Department messages alone to and from the Philippines for the last five months have averaged monthly a rate of over $325,000 a year."

This alone equals the interest at three per cent. on the sum of $10,645,000. It is reasonable to assume that the dispatches of the other departments of the Government would at least increase this amount by one-quarter, which would make the present Government cable tolls to and from the Philippines equal to the interest at three per cent. on approximately $13,500,000. Fully 90 per cent. of this sum goes to foreign corporations, while all Pacific cable expenditures would remain in the United States.

In an ocean cable enterprise, the largest item of annual expense is invariably the interest on the capital invested. No one can borrow money at a less rate than the United States Government, and furthermore as a Government enterprise, the cable is at once relieved from earning any sums for dividends, and is only required to maintain itself in a prudent and sound financial condition.

(To be continued.)

CRUISE OF THE "ALBATROSS."

THE following letter has been received by the United States Fish Commission from Prof. Alexander Agassiz. It is dated Papeete Harbor, Tahiti Island, September 30, 1899, and gives an account of the voyage of the "Albatross" up to that time.

I arrived at San Francisco on August 20, and after consulting with Commander Moser we decided to leave on Wednesday, the 23d. Everything shipped from the East had arrived with the exception of the tow nets sent me by Dr. Kramer, and the deep-sea nets kindly ordered for me by Prof. Chun, of Leipzig. Captain Moser and I decided not to make any soundings nor do any deep-sea work until we had passed beyond the lines of soundings already run by the "Albatross" and "Thetis" between California and the Hawaiian Islands.

In latitude 31° 10′ N., and longitude 125° W., we made our first sounding in 1955 fathoms, about 320 miles from Point Conception, the nearest land. We occupied 26 stations until we reached the northern edge of the plateau from which rise the Marquesas Islands, having run from station No. 1, a distance of 3800 miles, in a straight line.

At station No. 2 the depth had increased to 2368 fathoms, the nearest land, Guadeloupe Island, being about 450 miles, and Point Conception nearly 500 miles distant. The depth gradually increased to 2628, 2740, 2810, 2881, 3003, and 3088 fathoms, the last in latitude 16° 38′ N., longitude 130° 14′ W., the deepest sounding we obtained thus far in the unexplored part of the Pacific through which we are passing. From that point the depths varied from 2883 to 2690 and 2776, diminishing to 2583, and gradually passing to 2440, 2463, and 2475 fathoms, until off the Marquesas, in lat. 7° 58′ S., long. 139° 08′ W., the depth became 2287 fathoms. It then passed to 1929, 1802, and 1040 fathoms, in lat. 8° 41′ S., long. 139° 46′ W., Nukuhiva Island being about 30 miles distant. Between Nukuhiva and Houa-Houna (Ua-Huka) islands we obtained 830 fathoms, and 5 miles south of Nukuhiva 687 fathoms. When leaving Nukuhiva for the Paumotus we sounded in 1284 fathoms about 9 miles south of that island. These soundings seemed to show that this part of the Marquesas rises from a plateau having a depth of 2000 fathoms, and about 50 miles in width, as at station No. 29 we obtained 1932 fathoms.

Between the Marquesas and the northwestern extremity of the Paumotus we occupied 9 stations, the greatest depth on that line being at station No. 31, in lat. 12° 20′ S., and long. 144° 15′ W. The depths varied between 2451 and 2527 fathoms, and diminished to 1208 fathoms off the west end of Ahii, and then to 706 fathoms when about 16 miles N. E. of Avatoru Pass in Rairoa Island.

We developed to a certain extent the width of the Paumotu group plateau by a line of soundings in continuation of the direction of Avatoru Pass, extending a little less than 9 miles seaward, where we obtained a depth of 819 fathoms. Subsequently we ran a similar line normal to the south shore of the lagoon of Rairoa, a distance of nearly 12 miles into 897 fathoms.

Between Rairoa and Tikehau, the next island to the westward, we got a depth of 1486 fathoms.

Between Tikehau and Mataiwa 6 soundings were made with a depth of 488 fathoms half a mile from shore, and a greatest depth of 850 fathoms 6½ miles from Tikehau. The slope approaching Mataiwa is steeper than the Tikehau slope.

From Mataiwa to Makatea (Aurora) Island, we made 6 soundings: from 642 fathoms about 2½ miles off shore, to 581 fathoms about 1½ miles off the west side of the latter island, the depths passing to 860, 1257, 1762, and the greatest depth being 2267 fathoms; then 2243, and rising more rapidly near Makatea to 851 fathoms.

Between Makatea and Tahiti we made 8 soundings, beginning with 1363 fathoms, 2 miles off the southern end of Makatea, passing to 22 8, 2363 (the greatest depth on that line), 2224, 1930, 1585, 775, and finally 867 fathoms off Point Venus.

These make in all 72 soundings up to the present time.

The deep basin developed by our soundings between lat. 24° 30′ N. and lat. 6° 25′ S., varying in depth from nearly 3100 fathoms to a little less than 2500 fathoms, is probably the western extension of a deep basin indicated by two soundings on the charts, to the eastward of our line, in longitudes 125° and 120° W., and latitudes 9° and 11° N., one of over 3100 fathoms, the other of more than 2550 fathoms, showing this part of the Pacific to be of considerable depth, and to form a uniformly deep basin of great extent, continuing westward probably, judging from the soundings, for a long distance.

I would propose, in accordance with the practice adopted for naming such well-defined basins of the ocean, that this large depression of the Central Pacific, extending for nearly 30° of latitude, be named Moser Basin.

The character of the bottom of this basin is most interesting. The haul of the trawl made at station No. 2, lat. 28° 23′ N., long. 126° 57′ W., brought up the bag full of red clay and manganese nodules with sharks' teeth and cetacean ear-bones; and at nearly all our stations we had indications of manganese nodules. At station No. 13, in 2690 fathoms, lat. 9° 57′ N., long. 137° 47′ W., we again obtained a fine trawl haul of manganese nodules and red clay; there must have been at least enough to fill a 40-gallon barrel.

The nodules of our first haul were either slabs from 6 to 18 inches in length and 4 to 6 inches in thickness, or small nodules ranging in size from that of a walnut to a lentil or less; while those brought up at station No. 13 consisted mainly of nodules looking like mammilated cannon balls varrying from 4½ to 6 inches in diameter, the largest being 6½ inches. We again brought up manganese nodules at the Equator in about longitude 138° W., and subsequently—until within sight of Tahiti—we occasionally got manganese nodules.

As had been noticed by Sir John Murray in the "Challenger," these manganese nodules occur in a part of the Pacific most distant from continental areas. Our experience has been similar to that of the "Challenger," only I am inclined to think that these nodules range over a far greater area of the Central Pacific than had been supposed, and that this peculiar manganese-nodule bottom characterizes a great portion of the deep parts of the Central Pacific where it cannot be affected by the deposit of globigerina, pteropods, or telluric ooze; in the region characterized also by red clay deposits. For in the track of the great equatorial currents there occur deposits of globigerina ooze in over 2,400 fathoms for a distance of over 300 miles in latitude.

Manganese nodules we found south of the Marquesas also, where in 2,700 fathoms we obtained, perhaps, the finest specimens of red clay from any of our soundings. As we approached close to the western Paumotus, and rose upon the plateau from which they rise, globigerina ooze passed gradually to pteropod ooze, then to fine and coarse coral sand. In the channel south of the Paumotus to Tahiti the coral sand passed to volcanic sand mixed with globigerinæ in the deepest parts of the line, and toward Tahiti passed to volcanic mud mixed with globigerinæ, next to fine volcanic sand, and finally, at the last sounding, off Point Venus, to coarse volcanic sand.

We made a few hauls of the trawl on our way, but owing to the great distance we had to steam between San Francisco and the Marquesas (3,800 miles) we could not, of course, spend a great deal of time either in trawling or in making tows at intermediate depths. Still the hauls we made with the trawl were most interesting, and confirmed what other deep-sea expeditions have realized; that at great depths, at considerable distances from land and away from any great oceanic current, there is comparatively little animal life to be found. Where manganese nodules were found the hauls were specially poor, a few deep-sea holothurians and ophiurans, and some small actiniæ which had attached themselves to the nodules with a few other invertebrates, seemed to be all that lived at these great depths, 2,500 to 2,900 fathoms, far away—say from 700 to 1,000 miles—from the nearest land.

The bottom temperatures of the deep (Moser) basin varied between 34·6° at 2,628 and 2,740 fathoms to 35·2° at 2,440 fathoms, and 35° at 2,475 fathoms; about 120 miles from the Marquesas. At station No. 23, off the Marquesas, in 1,802 fathoms, the temperature was 35·5°.

Owing to the failure of our deep-sea thermometers, we were not able to make any satisfactory serial temperature observations. At station No. 11, lat. 14° 38′ N., long. 136° 44′ W., we obtained: 79° at surface, 38·7° at 50 fathoms, 55·9° at 100 fathoms, 48·9° at 200 fathoms, 44 1° at 300 fathoms, and 38·9° at 700 fathoms. These temperatures are somewhat higher than those obtained by the "Challenger" in similar latitudes on their line to the westward of ours, between the Sandwich Islands and Tahiti.

The temperatures of the bottom between the Marquesas and Paumotus were 34·9° at 1,932 fathoms, 35° at 2,456 fathoms and 2,451 fathoms, and 35·1° at 2,527 fathoms.

We did not take any bottom temperatures between the Paumotus and Tahiti.

Our deep-sea nets not having reached San Francisco at the time we sailed, we limited our pelagic work to surface hauls, of which we generally made one in the morning and one in the evening, and whenever practicable some hauls with the open tow nets at depths varying between 100 and 350 fathoms. The results of these hauls were very satisfactory. The collection of surface animals is quite extensive, and many interesting forms were obtained. As regards the deeper hauls, they only confirm what has been my experience on former expeditions: that beyond 300 to 350 fathoms very little animal life is found, and in the belt above 300 fathoms, the greater number of many so-called deep-sea crustaceans and deep-sea fishes were obtained. I may mention that we obtained Pelagothuria at about 100 fathoms from the surface.

We trawled at station No. 10 in 3,088 fathoms. Unfortunately the trawl was not successful, and we simply hauled the bag through over 3,000 fathoms without bringing up a single deep-sea animal from intermediate depths which we did not obtain quite near the surface—at less than 300 fathoms. I may mention here that the experience of the "Valdivia" shows, from the preliminary reports published by Professor Chun, that no pelagic algæ extend to beyond about 150 fathoms. Although he also states that animal life is found at all depths from the surface to the bottom, yet he states that beyond 800 meters it diminishes very rapidly. Professor Chun does not state whether this diminution is more rapid away from land than near continental areas, both of which conditions I had called especial attention to in my preliminary report on the "Albatross" expedition of 1891, while using the Tanner net in the Gulf of California. Mr. tieorge Murray has criticised the action of the Tanner deep-sea net and condemns its results, suggesting that the bottom net had always closed some time after being sent down. I need not now discuss that subject, but will only refer him to the report of the "Albatross," in which he will find the closed part of the net to have on several occasions brought up (when I expected it to do so) specimens from over 600 fathoms from immediately above the bottom, or samples of the bottom from near 1,700 fathoms while attempting to tow immediately above that depth.

I ought, in justice to him, to state that I omitted to mention that we secured the loops by twine to the detacher, to insure their dropping only when the messenger reached the detacher, and that the hooks of the detacher were lengthened very considerably above the dimensions figured in my preliminary report on the "Albatross" in 1891. I might add that we made a number of trials near the surface to see the action of the Tanner net under all conditions of position and speed, and I can only assume that Mr. Murray, having no experience, did not handle his net properly, or that it was not properly balanced. I may also add that Capt. Tanner used his modified net subsequently in the "Albatross," while running a line of soundings from San Francisco to Hawaiian Islands, in from 100 to 350 fathoms from the surface, at considerable distances from the islands and the mainland, and also in Alaskan waters, and always with the results we had obtained before. The closed bag, when towing at 100 fathoms below the surface, always brought up a mass of pelagic animals living at about that depth, while when tried at 300–350 fathoms, it brought up little or nothing. There is nothing in Capt. Tanner's experience or mine to indicate why the net should act well at 100 fathoms and not well at 300 fathoms or more, as suggested by Mr. Murray.

On our way to Tahiti from Marquesas we stopped a few days to examine the westernmost atolls of the Paumotus. Striking Ahii we made for Rairoa, the largest of the Paumotu group, skirting the northern shore from a point a little west of Tiputa Pass. We entered the lagoon through Avatoru Pass, anchoring off the village. This pass is quite narrow, with a strong current running out the greater part of the time, especially in easterly winds. It varies in depth between 9 and 10 fathoms, shoaling near the inner entrance to about 3½ fathoms, and deepening again to 6 or 7 fathoms, and gradually passing into 15 to 17 fathoms, which is the average depth of the lagoon from Avatoru Pass to the south or weather shore, a distance of about 13 miles.

We made an examination of the northern side of the lagoon, between Avatoru and Tiputa passes. The lagoon beach of the northern shore is quite steep, and is composed of moderately coarse broken coral sand at the base, and of larger fragments of corals along the upper face, which is about 5 to 6 feet above high water mark. These coral fragments are derived in part from the corals living on the lagoon face of the northern shore, and in part of fragments broken by the waves from somewhat below the low water mark. The ledge which underlies the beach crops out at many places on the lagoon side of the northern shore; we traced it also along the shores of the Avatoru Pass, and about half way across the narrow land running between Avatoru and Tiputa passes. It crops out also at various points between them in the narrow cuts which divide this part of the northern land of the lagoon into a number of smaller islands. These secondary passes leave exposed the underlying ledge, full of fossil corals. In some cases there is left a clear channel extending across from the lagoon to the northern side, through which water flows at high or half tide. In other cases the cuts are silted up with coral sand blown in from the lagoon side. In others, the cut is shut off by a high sand bank, or a bank composed of broken fragments of corals, leaving access to the water from the northern shore only; and finally the cuts are also shut off on the northern side by sand and broken coral banks, the extension of the north shore beach leaving a depression which at first is filled with salt water and gradually silted up both from the lagoon side and the sea side, and forms the typical north shore land of the lagoon. This building up of the land of the Paumotu atolls simultaneously both by the accumulation of sand from the lagoon side and the sea face is very characteristic of the atolls of that group. It is a feature which I have not seen so marked in any other coral reef district.

On the lagoon side the slope from the beach is very gradual into 16 and 17 fathoms, and corals appear to flourish on the lagoon slope to 6 or 8 fathoms only, in some cases consisting of Madrepores, Porites, Astræans, and Pocillopores. The corals could be seen over the floor of the Avatoru pass down to 9 to 10 fathoms; and on the sea face Pocillopores covered the outer edge of the shore platform. This platform is from 200 to 250 feet wide, and was formed by the planing off of the seaward extension of the ledge cropping out in the cuts.

It became very evident, after we had examined the south shore of the lagoon, that the ledge underlying the north shore is the remnant of the bed, an old tertiary coralliferous limestone, which at one time covered the greater part of the area of the lagoon, portions of which may have been elevated to a considerable height. This limestone was gradually denuded and eroded to the level of the sea. Passages were formed on its outside edge, allowing the sea access to the inner parts of the lagoon. This began to cut away the inner portions of the elevated limestone, forming large sounds, as in the case of Fiji atolls, and leaving finally on the south side only a flat strip of perhaps 2,500 to 3,000 feet in width, which has gradually been further eroded on the lagoon side and also on the sea face to leave only a narrow strip of land about 1,000 feet in width and perhaps 10 to 14 feet in height, the material for this land having come from the disintegration of the ledge of tertiary limestone, both on the sea face and the lagoon side.

There exist at the lagoon side of both Avatoru and Tiputa passes a number of small islets which also consist of this same tertiary limestone in process of disintegration and transformation to coral sand islets; two of these we found along our line of soundings, the one about 4½ miles from the north side of the lagoon, and the other about the same distance from the south shore. I am told that the eastern extremity of the lagoon is filled with islets and heads consisting of the same limestone rock so characteristic of the north and south shores of the lagoon.

The underlying ledge is not the remnant of a modern reef; its character is identical with that of the elevated limestones of Fiji, which are of tertiary age, and the rock is in every respect the same as that I observed on many of the elevated islands of Fiji. The atoll of Rairoa is in a stage of denudation and erosion very similar to that of Ngele Levu, in Fiji, only in Ngele Levu the elevated limestone attains a height of about 60 feet. Our visit to the south shore of the lagoon, both on the lagoon side and on the sea face, left us no doubt regarding the character of the underlying ledge of the north shore. As soon as the south shore was sufficiently near, as seen from the lagoon side, for us to distinguish its character, we could see that the entire shore line was formed of a high ledge of limestone, honeycombed, pitted, and eroded, both by atmospheric agencies and the action of the waves in its lower parts both on the lagoon side and on the sea face. The great rollers of the weather side broke through between the columnar masses of the ledge into the lagoon, and as far as the eye could reach there extended a more or less continuous wall (which is described by Dana as he saw it sailing by in the "Vincennes"). But, on landing, we found this wall to be the sea face of the islands and islets which dot the weather side for the greater part of its length on the southwestern part of the lagoon. These islands and islets are entirely composed of coral sand and coral fragments, formed from the disintegration of the extension of the elevated ledge toward the inside of the lagoon to a distance of about 1½ to 2 miles; and along this very gradual slope of the islands forming the southern edge of Rairoa, corals grow profusely down to 6 or 7 fathoms of water, when the bottom runs into hard coralline bottom similar to that found on all the soundings taken across the lagoon.

The width of the larger islands is about 1000 to 1200 feet, the smaller islands and islets are less, some of the latter forming in reality mere sand buttresses at right angles to the great limestone ledge which flanks them all on the sea face and connects them on the weather side as if by a great wall, more or less broken, and shuts off the communication of the interior of the lagoon with the sea on that side.

The passages between the islands and islets illustrate well, only on a larger scale, the formation of the cuts, more or less silted up, which were observed on the northern face of the lagoon. Some of these passages are dry at low water, others are partly filled by tide pools, others are entirely silted up by lagoon sand, only they are lower than the sand-blown land of the islands on either side.

Crossing over to the weather side of the southern land of Rairoa, in one of the passages between two of the islands we came upon the limestone ledge, from 12 to 14 feet high and about 40 to 50 feet wide, which formed the sea face of the islands and islets, and extended far to the westward as a great stone wall more or less broken into distinct parts. We found this ledge to consist of elevated limestone as hard as calcite, full of corals, honeycombed and pitted, and worn into countless spires and spurs, and needles and blocks of all sizes and shapes, separated by deep crevasses or potholes, recalling a similar scene in Ngele Levu on the windward side of the lagoon. In the passages the parts of the ledge which had not been eroded extended as wide buttresses, gradually diminishing in height till they formed a part of the lagoon flat and extended out below the recent beach rock which covered it in short stretches.

The slope of the sea face of the elevated ledge was quite steep and similar to the lagoon slope, its upper surface weathered by atmospheric and aqueous agencies into all possible shapes such as I have mentioned. The slope passed into the shore platform, which was shaved down, as it were, to a general level surface. On the outer edge, within the line of the breakers, were growing Pocillopores in great abundance. This reef flat or shore platform, as well as the reef platform of the north shore, was strewn here and there with huge masses of the ledge of elevated reef rock torn from its outer shore. Similar rocks and bowlders occur on the lagoon side of the islands forming the outer lands of Rairoa; they are either torn off from the lagoon face of the outeropping ledge or are parts of the ledge which have remained in place and have not been planed down to the base level of the reef.

The amount of water which is forced into such a lagoon as Rairoa is something colossal, and when we observe that there are but a small number of passages through which it can find its way out again on the leeward side, it is not surprising that we should meet with such powerful currents (7 to 8 knots in several cases) sweeping out of the passages on the lee sides.

The islands and islets of Rairoa are fairly well covered with low trees and shrubs and great groves of palm trees.

The atolls of Tikehau and Mataiwa, which we also examined, present no features which we did not meet in Rairoa. The first-named atoll shows the same method of formation of the land by material piled up both from the lagoon side and the sea face; material derived from the disintegration of the underlying tertiary limestone which crops out here and there along the sea face and the inner shores of the lagoon, or forms across the southwest face of the lagoon a more or less disconnected part of the ring of islands and islets encircling that of the lagoon. These islets and islands are irregularly connected by fragments of the elevated limestone ledge, attesting its greater extension in past times. The outer rings of both these atolls are covered with vegetation. We could see in the lagoons several rocky islets, the fragments of the elevated limestone ledge.

Mataiwa is interesting, as its lagoon is quite shallow; it is full of rocky islets, remnants of the underlying limestone ledge which crops out above the general level, and has a very narrow and shallow entrance, passable for boats only. Some of its islands are wooded and appear to have been formed by accretions of sand from the decomposing ledges of the lagoon. The outer ring of land appears formed by sand banks driven in from the sea face and driven out from the lagoon side by the action of the waves. It is evident that such a lagoon as Mataiwa could readily be closed to any access to it by the sea, as it now has only one very narrow and very shallow boat passage connecting the lagoon with the sea on the lee side.

It was with great interest that we approached Makatea, as it is the only high elevated island of which Dana speaks as occurring in the western Paumotus. For, though he mentions some others as possibly having been elevated five to six feet, yet he considered them all, as well as Makatea (Metia or Aurora, of Dana), as modern elevated reefs. Yet from the very description given by him of the character of the cliffs and of the surface of Makatea, I felt satisfied that it was composed of the same elevated coralliferous limestone so characteristic of the elevated reefs of Fiji, and which, from the evidence of the fossils and the character of the rock, both Mr. Dall and myself have been led to regard as of tertiary age.

As we approached the island from the northwest, it soon became evident that it presented all the characteristics to which I had become so accustomed in Fiji, and, upon landing, this was found to be the case. The cliffs had the same appearance as those of Vatu Leile, Ongea, Mango, Kambara, and many other elevated islands of Fiji. There were fewer fossils, perhaps, but otherwise the petrographic character of the rock was identical with that of Fiji. Mr. Meyer collected upon the top of the second terrace a number of fossils similar in all respects to those we found in the Fiji elevated coralliferous limestones.

The southwestern extremity of the island sloped gradually to the sea and showed two well-defined terraces. The lines of these two terraces could, as a rule, be traced along the faces of the vertical cliffs by the presence of caverns along the lines of those levels, similar to the line of caverns indicating the line of present action of the sea at the base of the cliffs. As we steamed around the island there were distinct indications of two additional terraces on the line of the vertical cliffs on the weather side of the island. The position of these terraces was usually more clearly seen along the face of the cliffs at prominent points where they were undercut much as I have figured them for certain cliffs in Vatu Leile, in Fiji, in my report on the islands and coral reefs of that group.

Of course it is premature from this examination of the western extremity of the Paumotus to base any general conclusions regarding the mode of formation of these atolls; certainly as far as I have gone there is absolutely nothing to show that the atolls of the Paumotus have not been formed in an area of elevation similar to that of Fiji. The evidence in Rairoa and in the atolls of the western Paumotus is very definite. Makatea is an elevated mass of coralliferous limestone similar in all respects to masses like Vatu Vara, Thithia, and others in Fiji. Like them Makatea is surrounded by a comparatively narrow shore platform cut out from the base of the limestone cliffs and on the seaward extension of which corals grow abundantly to depths of seven to eight fathoms, when they appear to become very much less numerous. So that it is not unnatural, as I am inclined to do, to look upon the area of the Paumotus as one of elevation, the raised and elevated land of which has been affected much in the same way by denudation and erosion as have the masses of elevated coralliferous limestone of Fiji. Only there seems to have been, from the evidence thus far presented, a far greater uniformity in the height of the elevation of the Paumotus. This would render the explanation I have given less evident had I not the experience of the Fiji group to guide me. I am informed that there are other islands and atolls in the Paumotu group showing traces of this elevation, so that I am at any rate justified in denying that the Paumotus as such are situated in an area of subsidence and that subsidence has been the great factor, as is maintained by Darwin and Dana, in the formation of the characteristic atolls of the group.

It may be well to point out also that the Paumotus, like the Marquesas on one side and the Society Islands on the other, are situated upon a plateau similar to that upon which the last-mentioned groups are placed —this plateau having a depth of from 1,200 to 1,500 fathoms and rising from the general oceanic basin which surrounds them and which has a depth of from 2,300 to 2,500 fathoms. Furthermore, evidence of this elevation is found at the two extremities of the Paumotu plateau, at Makatea, an elevated island consisting of tertiary coralliferous limestone and at the Gambier Islands which are volcanic islands of considerable height.

A. AGASSIZ.

GERMAN ECHOES OF THE COMMERCIAL EXPOSITION.

WHEN, a few months ago, prospectus and plans for the exposition of the Philadelphia Commercial Museum were circulated in Germany, they were generally received with either indifference or ill-concealed resentment, says Consul General Frank H. Mason, of Berlin. The invitations which were extended to European delegates, offering the hospitality of the exhibition and an opportunity to participate in its proceedings, did something, but not much, to allay the general suspicion that the whole enterprise was simply a scheme to foster American export trade at the expense of rival manufacturing nations in Europe. The debates in German chambers of commerce over the question of accepting or declining that invitation were mainly a rehearsal of the grievances of German exporters against the tariff, the Treasury and custom-house regulations the too alert and searching activities of the United States consuls, and the defects in American merchandise. A memorable feature of that period was the reputation suddenly won by a member of the chamber of commerce at Cologne, through a specially tart and sarcastic letter which he had sent to Director Wilson in declining his invitation to attend the exposition as a delegate. There were not wanting business men and influential newspapers which took a broader, more liberal view of the case, and, as the expression of their judgment, a delegation, limited as to numbers, but of the highest ability and efficiency, was sent to represent German interests at the exposition. These delegates, most of whom made extensive journeys through the Southern, Western, and New England States, where they examined the principal industries of each section, have now returned and have, through newspaper interviews, lectures before boards of trade and various industrial associations, disseminated a vast amount of fresh and original information concerning the United States.

The effect of these reports—attended as they have been by the Samoan agreement and the Executive suggestion of a joint commission to study with scientific thoroughness certain questions which are now more or less at issue between the two countries—has been to change suddenly and to a surprising degree the tenor of newspaper comment and popular feeling toward the United States.

While the reports and lectures of the returned delegates deal with a wide range of subjects, which they have studied from somewhat different standpoints, there are certain conclusions concerning which they all agree. Among these is the judgment that the commercial exposition has been unexpectedly successful, and will exert an important influence upon the immediate future of international commerce. The German delegates were surprised by the numbers and high character of the representatives of other nations, particularly those from Great Britain, South and Central America, Australasia, and Eastern Asia. They were intensely interested in the display of commercial samples from foreign countries, but think that, in consequence of the rapid change in styles and models, these will have for the most part only a temporary value. On the other hand, they have found the Bureau of Commercial Information at Philadelphia a model of completeness and efficiency, far in advance of any other institution of its kind yet organized in Europe, and a model for the immediate imitation of Germany and other exporting nations which hope to maintain their place in future competition. The recent address in Berlin of Dr. Vosberg-Rekow, director of the association of German business men for the preparation of commercial treaties, was emphatic on this point, and an important meeting will be held on the 15th instant to discuss the part which the Imperial government will be asked to take in supporting such an enterprise. The annual meeting of this powerful association, which acts as a purveyor of technical and commercial information for the government, is fixed for December 19 and 20. The principal topic before the meeting will be the proposed creation of a commercial museum and bureau of information, to be organized and managed on lines similar to those of the same institutions at Philadelphia.

Dr. Vosberg-Rekow's declaration that he had critically examined the processes of meat inspection and preparation at Chicago, and had found them admirable, is the first official testimony of that kind which has been able to check and silence—for the moment, at least—the long sustained and tedious chorus of agrarian denunciation of American food products. His address was delivered before the Berlin Association of Mechanics and Manufacturers, the members of which are generally men of superior intelligence, who are above the small jealousies and selfishness of trade and who realize how dependent are the industrial and laboring classes in German cities and manufacturing districts upon imported breadstuffs and meats.

In the course of his address, the speaker described his visits to American manufacturing establishments, and said:

"When you read the figures which mark the present condition of industry and trade in the United States, you will conclude that they are smart fellows over there, and we must bestir ourselves if we hope to keep up with them.

"When one examines the industries of America, one is amazed by the gigantic strength, the pristine power of that people, and realizes that Americans will play henceforth an important rôle in the economic affairs of the world. Nevertheless, a nearer examination shows that the development of American industry is not symmetrical or complete; there are gaps and points of weakness here and there. One industry may be very highly developed, while a correlative branch is primitive and neglected. One notices that American manufacturers are generally not broadly educated, though they are skillful and well informed in their separate specialties. They are highly original and ingenious, and when they seriously take up any special branch of manufacture they soon explode and supersede the older methods of Europe. For all this, we need not greatly fear the Americans. Their training is too incomplete and one-sided to render them successful competitors in the long run."

Similar in tenor and deductions was the report of Herr Wirth, a linen manufacturer of Sorau, who had attended the exposition as the representative of the

chamber of commerce in that busy city. In his report, which was delivered before a special meeting a few days ago, Mr. Wirth confirmed the principal observations of Dr. Vosberg-Rekow, described the impression made upon him by the great factories of Pennsylvania and New England, the four-tracked railway lines crowded with traffic, and the resistless energy and enterprise of the people. "Great as industrial Germany has become," said the speaker, "she is yet far behind the Republic in natural resources and productive capacity." All that he saw emphasized the importance of closer and more friendly relations between the two countries, whose exchanges of raw materials and certain manufactured products are essential to the prosperity of both.

In opportune, though apparently accidental, accord with these manifestations of a friendlier spirit, there has appeared within the past few days an important contribution to the controversy concerning the danger to German farms and orchards through the invasion of insect pests of American origin. When in January, 1898, the sudden and drastic edict of the German government concerning the San José scale practically paralyzed the import of fresh fruits from the United States, Dr. H. Dohrn, of Stettin, a scientific horticulturist of high authority, declared and gave reasons for his opinion that the new pest would, for climatic and other reasons, prove as harmless in Germany as the Colorado potato bug had been several years ago. As a result of the discussion which followed, the horticultural society at Stettin, of which Dr. Dohrn is an old and influential member, offered a prize for the best scientific treatise on the whole question of American insects pests in Germany.

The prize has just been awarded to Prof. Leopold Krüger, whose essay fills a volume of 174 pages and traverses the whole subject with the minute, painstaking thoroughness and fidelity which are characteristic of scientific research in Germany. The conclusions of Prof. Krüger are summarized in the two following sentences:

"(1) That until now, no insect of any importance or danger to agriculture has ever been introduced from North America into Germany.

"(2) That the climatic differences between the two countries render highly improbable any noxious invasion from that country, so that there is no fact to justify or render advisable any panicky fear, such as now prevails concerning the invasion of the San José scale and was formerly awakened by the Colorado potato bug."

In the latest number of Die Nation, a leading scientific and literary weekly, Dr. Dohrn returns to the attack with a comprehensive view of Mr. Krüger's work, citing at length the convincing proofs therein set forth, points out the failure of the imperial health office in all its publications on this subject to make any allusion to the successful efforts of the California fruit growers to fight the scale with its natural insect enemies, and closes his article with the following challenge:

"For some time, the expert officials of the imperial health office have, as has been clearly shown, become convinced that the San José scale is less to be feared in Germany than the potato bug in former times. Is it not high time, now that the grounds of this fear have been eliminated, to repeal the restrictive measures that were based upon that supposed danger?

"The fruits coming from America—fresh as well as dried—are to-day subject to the same stringent regulations as in January, 1898. And there are to be considered not only the difficulties and delay, but likewise the important pecuniary charges which now inure to the benefit of certain officials who are charged with the wholly useless examination of these fruits in search of living or dead parasites. I remember a case in which a merchant at Stettin imported several barrels of American apples, worth altogether about 80 marks ($19). For the inspection of this fruit he had to pay a fee of 8 marks ($1.90), and for additional storage during the delay caused thereby 2 marks (48 cents); in all, 12½ per cent. of the total value of the merchandise. I assume that in case of large shipments, this enormous charge would be proportionately reduced; but it would still amount to a heavy tax, which is expended for no useful purpose whatever. And if the Imperial Government does not, of its own accord, put an end to this system, it is to be hoped that the Reichstag will accord to the facts now established by this research the recognition to which they are so fully entitled."

The chamber of commerce of one of the leading Rhine cities has recently declared in its annual report that no German scientist has been able to prove whether the San José scale found on American fruit was alive or dead, and the frank scientific conclusions of Prof. Krüger will help to give a final quietus to the San José scale as a menace to the horticulture of Germany.

Camel races are held regularly in the south of Algeria, where valuable prizes are offered for the encouragement of the breed of racers, and as much interest is taken in their preparation and performances as in that of race horses at Latonia. The racing camels are the result of very careful breeding through many generations, and in size, temper, and appearance they are so different from the ordinary beast of burden that they might almost be considered a different race of animals. Perhaps the most conspicuous characteristic of the ordinary camel is its extreme slowness. Nothing on earth will ever induce it to hurry. Twenty-five dollars will buy a very fair specimen, but for a mehart, or racing camel, five or ten times that sum is required to effect a purchase. The racer, however, can be depended on for nine or ten miles an hour, and kept up for sixteen or seventeen hours almost without a stop. The pace in a camel race is generally fast and furious at the beginning, when all the animals are together and seem to realize that a contest is in progress.

In modern wind machines it is calculated that a 14-foot wheel will yield ¼ horse power with a 10-mile wind, ½ horse power with a 12-mile wind, 1 horse power with a 16 mile wind, and 2½ horse power with a 25-mile wind, says The Engineer. A 20-foot wheel will give 1¼ horse power at 10 miles, increasing to 5½ horse power at 25 miles. A wheel 30 feet diameter is estimated to produce from 3 horse power at 10 miles to 9 horse power at 25 miles velocity; a 40-foot wheel ought to give from 5 to 12 horse power.

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